AGRICULTURAL RESEARCH IN NORTH CAROLINA

1939-1940

Agricultural Experiment Station
North Carolina State College of Agriculture and Engineering
of the
University of North Carolina

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Sixty-second and Sixty-third Annual Reports
of the
Agricultural Experiment Station
North Carolina State College of Agriculture and Engineering
of the
University of North Carolina
For the Fiscal Period July 1, 1938 to June 30, 1940
Progress Report for the Two Years Ending November 30, 1940
Raleigh

STATE INSTITUTIONS COOPERATING IN AGRICULTURAL RESEARCH

State College of
Agriculture and Engineering
of the University of North Carolina

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Raleigh, N. C.

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* The six branch stations are owned and operated by the North Carolina Department of Agriculture, and the employees on these farms are members of the Department of Agriculture staff.

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To the Governor of North Carolina, the Board of Trustees and President of the University of North Carolina and the Dean of Administration of the North Carolina State College of Agriculture and Engineering:

I am transmitting herewith the report of the Agricultural Experiment Station for the biennium ending June 30, 1940.

Respectfully submitted,

ROBT. M. SALTER, Director,
NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION.

FOREWORD

Agriculture is both a business and a way of life. Its practice combines both art and science. Upon its productivity depends both the economic and social welfare of the Nation.

The farmer is engaged in one of the most speculative of enterprises. His business is to produce living plants and animals whose laws of growth are still imperfectly understood. He is at the mercy of natural forces, for the most part beyond his control. He must sell his wares in markets subject to economic forces equally beyond his control. Precise rules for success cannot be laid down. Neither is success measurable in terms of dollars alone. Satisfactions, many wholly unrelated to cash income, are a part of successful life on the farm.

On every farm, the experience of the farmer himself, that of his neighbors around him, and the accumulated knowledge handed down by past generations on the land, furnish much of the basis for sound farming practice. Every wise farmer knows, however, that gaining new information to meet new conditions through experience alone is apt to be a slow and costly process. Changing market conditions, the appearance of new insect pests and diseases, the development of new sources of plant food, the invention of new agricultural machines, all create demands for new information. To gain this information in minimum time and at least cost to the individual farmer, central agencies for agricultural research have been set up by government. The agricultural experiment stations in the states and the Federal Department of Agriculture serve this function. Their job is to apply the tools of modern science—chemistry, physics, physiology, genetics, and a host of others—to the problems of the farmer, aiming to discover principles upon which sound solutions can be based. This is not a simple task. The research worker is beset by the same whims of Nature as the farmer. No two animals, two plants, or two seasons are ever exactly alike. Often years of testing are required to establish the superiority of a new crop variety, of a new method for controlling disease, or of a new system of animal feeding. Premature release may easily entail heavy losses to farmers. Moreover, the number of problems demanding solution invariably exceeds the human, physical and financial resources of the research agencies. These facts bespeak patience on the part of the farmer. They do not justify a "dilly-dally" attitude on the part of the research worker or the devotion of his energies to problems having little or no practical significance, regardless of how interesting they are scientifically.

The staff of the North Carolina Agricultural Experiment Station is fully mindful of its responsibility to the farmers of the state. Within the limitation of the facilities at its command, it is making an honest effort to render maximum service by vigorous and thorough attack on what are believed to be the most critical problems confronting agriculture in the state. The task is made easier, the scope of work broader, and the whole program more effective by the invaluable assistance of cooperating agencies. These include all the research bureaus, the Soil Conservation Service and Forest Service of the U. S. Department of Agriculture, the Tennessee Valley Authority, and a number of commercial industries dependent upon agriculture. Several of these agencies are contributing sizeable funds to research in the state.

Of special value is the assistance rendered by the North Carolina Department of Agriculture whose major, although by no means sole contribution to the research problem, consists in the operation and support of the six outlying Branch Experiment Stations. These afford facilities for state-wide testing of new practices equalled in few other states. Recognition is also made of the fine cooperation given by individual farmers in almost every county, this cooperation in many cases involving services for which only inadequate or no compensation whatever can be made.

Discovery of new facts in answer to farm problems would be largely wasted effort without an effective means for acquainting farmers with them. Fortunately, this need is well met in North Carolina by the Agricultural Extension Service whose function it is to disseminate and demonstrate improved farm practice throughout the state. Another partner in this educational process is the Department of Vocational Education, which, through its teachers of agriculture in the high schools, passes on the findings of research to the on-coming generation of farmers and farm leaders.

Agriculture in North Carolina is today faced with the necessity of major adjustments. In part the aftermath of the first World War, and in part a reaction to the present war with its dislocation of foreign markets, the outlets for cotton and tobacco, long the dominant sources of farm income, have so shrunken that it has been necessary to reduce acreages through the control programs by about one-third. The opportunity to regain lost markets after the present emergency seems remote in the case of cotton and doubtful for tobacco. New and profitable uses for these empty acres is imperative if farm incomes are to be maintained at satisfactory levels. Finding new cash crops offers some promise but little for the immediate future. The same is true as regards expanding the demand for crops now grown by discovering new industrial uses for them. Many signs point toward increased production of livestock, including poultry, as the most desirable solution to the problem. The defense effort has not only greatly increased the demand for livestock products in the state, but it has focused attention on the fact that production of such products has been considerably short of the amounts needed for adequate diets of farm families and still less adequate to meet the needs of the rapidly growing urban population of the state. Moreover, economic livestock production requires major reliance upon improved pastures and high quality forage crops for feed. Because these crops tend to improve soil and protect it from erosion, their extensive use might well be expected to rebuild much landed depleted by decades of row cropping.

Contemplating a development toward livestock raises a host of questions. What crops to grow, how to grow them, how to harvest and store them, how to feed for greatest economy of production, how to control animal diseases and parasites, how and what to market, and even how to lease land under a livestock system to insure equitable return to both owner and tenant are just a few of them. The right answers to these questions can be obtained best through agricultural research, intelligently planned and effectively executed.

Recognizing that agriculture holds a vital position in the economy of North Carolina, that it is faced with many new problems in this period of adjustment, and that new information is critically needed, the State of North Carolina has seen fit to increase materially its support of agricultural research. Farmers have special cause for gratification in this constructive action.

The purpose of this report is to present in practical language the results of typical phases of the work of the Experiment Station for the two-year period ending November 30, 1940. It is hoped that it may bring about a broader understanding and appreciation of the role of agricultural research in promoting the welfare of all citizens of the State.

ROBERT M. SALTER,

Director.

FIELD CROPS

Corn

Corn Hybrids from North Carolina Excel Out-of-State Hybrids

Corn yields have been increased as much as 30% in field trials with hybrid corn at five branch stations and two cooperating farmers. Of the 756 hybrid entries that were tested, 45½% outyielded the best local variety. Corn hybrids that have been made up of North Carolina breeding stock have consistently shown their superiority to out-of-state hybrids. Multiple top crosses of out-of-state single crosses (inbreds) with local varieties show considerable promise. Several Kentucky and Tennessee hybrids proved consistently good in the Piedmont and Mountain areas.

Out-of-state hybrids have shown an almost complete lack of adaptation. Early maturity, soft, poor quality grain, and susceptibility to weevils, earworms and birds make them of questionable value for farming in North Carolina, except possibly as an early corn for hogging off or other special purposes. All experimental evidence to date points to the necessity of including local breeding stock in all corn hybrids in order to obtain good quality corn.

Crop Rotations Help to Maintain Yields of Corn and Wheat in Piedmont and Mountain Areas

Field experiments at Statesville and Swannanoa have shown that the yields of corn and wheat grown in rotation are from two to three times larger than the yields obtained from a continuous cropping of the soil to these crops. A 3-year rotation of corn (cowpeas), wheat and red clover has increased the corn yields at Statesville from 16 to 53 bushels; wheat yields have been raised from 10 to 23 bushels. Although lime is the first essential for the production of red clover in the rotation, satisfactory yields are only produced when phosphates and potash are applied. The beneficial effects of the rotation are increased by proper fertilization with nitrogen, phosphoric acid and potash. Excessive liming produced severe potash deficiencies. Two-year rotations were ineffective.

At Swannanoa in a 3-year rotation of corn, soybeans, wheat (lespedeza), the yields of corn and wheat are maintained only when the legumes, soybeans and lespedeza, are plowed under as soil-improving crops. When soybeans and lespedeza were cut for hay, the yields of corn and wheat have been decreased. Rather severe potash deficiency symptoms occurred when these legumes were removed for hay.

Corn Yields Increased with Crotalaria in the Coastal Plain

Corn grown in alternate years in a rotation with crotalaria at the Lower Coastal Plain Branch Station at Willard produced an average yield of 39 bushels per acre as compared with a yield of 23 bushels produced by continuous corn. When a corn-corn-crotalaria rotation was used, the corn yields

dropped to an average of 29.5 bushels per acre, and nearly all of the increase was obtained in the first year following the crotalaria. All of the corn received 300 pounds per acre of 4-8-4 before planting and 50 pounds of sodium nitrate during the early part of the growing season.

The fertilization of crotalaria with 300 pounds of 4-8-4 increased the growth of crotalaria but had no significant effect upon the yield of corn in the following season. Corn yields have not been affected by harvesting the crotalaria seed.

Time of Planting Important in Corn Earworm Control

The extent of infestation of corn ear worm depends both on the number of earworm moths laying eggs and on the acreage of corn in the silking stage. Weekly counts of eggs on fresh silks over a number of years have shown that the number of eggs per ear at Raleigh decreases sometime in July when the greatest amount of field corn is in silk. The low point has varied from July 12 to 35 and is often still low up to August 1, but soon increases and reaches a maximum late in August. From the standpoint of earworm infestation alone, it would be desirable to plant corn so that it would silk near the middle of July in the vicinity of Raleigh.

Out of a great many materials tested for earworm control on sweet corn roasting ears, the most satisfactory results have been obtained from the use of U. S. P. white petroleum oil of 200 to 300 second viscosity (Saybolt). This is a medicinal grade of oil but only a small quantity is needed for each ear. The method has given good results on varieties having a tight husk extending well beyond the tip of the ear.

Cotton

Soil Type Affects Results Obtained with Nitrogen Fertilizers on Cotton

Fertilizers containing 20% of the nitrogen from cottonseed meal (an organic source) produced larger yields of cotton on soils of a sandy nature, such as sands and sandy loams, than fertilizers in which all the nitrogen was from the mineral sources, ammonium sulfate, urea-ammonia solution base goods or ammonium nitrate solution base goods. On fine sandy loams or soils with a finer texture, fertilizers with all the nitrogen derived from mineral sources have produced equally as good yields of cotton as those with 20% of the nitrogen derived from cottonseed meal.

With regard to the time of applying nitrogen fertilizers, where all the nitrogen in the mixed fertilizer was applied at planting time on sands and sandy loams, slightly less seed cotton was produced than where two-thirds of the nitrogen was applied at planting and the remain one-third was applied as a side-dressing.

The time of applying nitrogen had little effect on yields when cotton was grown on fine sandy loams or soils with a finer texture.

Breeding Better Cotton by Changing the Number of Chromosomes[1]

Commercial cottons come from several species, including Asiatic types which have 13 chromosomes (thread-like bodies in the cell in which the various hereditary factors are found) and American cottons, such as Upland and Sea Island which have 26 chromosomes. There are also at least a dozen wild species, mostly with 13 chromosomes, which will cross with cultivated cottons. The offspring, however, are usually sterile.

It is possible to double the number of chromosomes in the cotton plant by treating the plant with a drug known as colchicine. When the chromosomes are doubled in any cotton species the resulting flowers are usually sterile or nearly so. On the other hand, when the chromosomes are doubled in a sterile hybrid, the flowers become fertile. Seed is set but most of the offspring do not breed true.

Since American cultivated cottons have 26 chromosomes, twice the basic number, it is questionable whether they have originated by the doubling of a 13 chromosome species or by the doubling of a hybrid between two 13 chromosome species. Certain investigations have attributed the cultivated cottons to the doubling of the chromosome in a cross between an Asiatic and a wild American cotton. Such a sterile hybrid has been produced many times by using a Chinese cotton and a wild shrub native to Arizona which does not even possess lint. When this hybrid was treated with colchicine, the chromosomes were doubled to give the same number as that in the Upland cottons. This doubled hybrid is pollen sterile but sets fruit readily when supplied with Upland pollen. These seeds give rise to a triple hybrid—Upland (26 chromosomes) by Chinese (13 chromosomes) by Arizona shrub (13 chromosomes). The resulting plant is fertile.

There are a number of desirable properties in wild and Asiatic species of cotton which are not found in the Upland types. Previously it had been impossible to bring these properties into the Upland cottons by means of crossing since the hybrids are sterile. Colchicine, however, provides a method whereby these properties may be introduced into Upland cottons. For example, the aforementioned triple hybrid possesses fibers which are much superior to those of the Upland parent in strength, fineness and uniformity. This hybrid has low yield. Attempts are now being made to build up the strength factor in Upland cottons by means of backcrossing. In the third generation, the prospects look rather promising.

New Strains of Cotton Appear Promising[1]

A new strain of the Mexican variety has been produced at the Upper Coastal Plain Branch Station. It is earlier, more productive, and makes a smaller growth than the parent variety. The staple length of 1 inch or better should meet the requirements of mills in areas using inch cotton.

A large number of hybrids and selections from other varieties were grown at both Statesville and Rocky Mount. A few were outstanding and others showed considerable promise. Further testing will determine their value to North Carolina farmers.

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[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

Cheap Insurance for Better Stands of Cotton Found in Seed Treatment

A large part of the cotton seed produced in the Southeastern States has on it the spores of parasites that destroy cotton seedlings in large numbers. Still other parasites are often present in the soil in which the seeds are planted. A large measure of protection can be given to cotton seed by certain treatments such as dusting and delinting the seed before planting. Dusting consists of applying to the seed some chemical poisons to spores of parasites that attack young cotton plants. Delinting may be done mechanically by reginning the seed or chemically by use of sulphuric acid.

Fig. 1.—More cotton plants on rows planted to treated seed. Seed not dusted: middle row, second row right, and third row left. Seed dusted: first row right, first and second rows left.

Experiments have shown that dusting cotton seed before planting almost invariably increases emergence and survival of seedlings. Ceresan and New Improved Ceresan, which are commercial preparations containing mercury, have been found to be very effective for this purpose. The percentage increase due to use of these materials has been found to be correlated with the load of disease spores carried by the seed. When the planting seed were heavily infested with disease, benefits were relatively small. Increase of plant stand from dusting seed carrying little or no disease is usually large enough to more than pay the cost of dusting.

Reginning before planting removes much of the short lint normally present on cotton seed and makes for greater uniformity of planting. This treatment, however, leaves many disease spores on the seed. Such seed should always be dusted before planting. Reginned seed has produced as

good stands of seedling in all years and significantly better stands than natural seed in 2 out of 3 years in which this type of seed has been used.

Delinting with acid removes all the lint and destroys practically all the disease spores on the seed. Acid delinted seed come up more rapidly than undelinted seed in dry soil but sometimes drown when heavy rains immediately follow planting. Acid delinted seed should be treated with some effective chemical dust before planting to decrease seed decay in wet soil. It is recommended that dusting be adopted as a routine practice in the preparation of cotton seed for planting.

Resistant Varieties and Liberal Amounts of Potash Control Cotton Wilt[1]

Cotton wilt causes considerable losses to growers each year in the southern Coastal Plain counties. Yields are often reduced 50% or more when non-resistant varieties such as Coker 100, Farm Relief, and others are grown on soils infected with wilt. The use of highly resistant varieties will prevent most of these losses. Clevewilt, Coker 4 in 1, Dixie Triumph, and Wannamaker Early Wilt have been found to be highly resistant and to produce good yields of the desired staple length.

The use of 4% of potash in the fertilizer reduced the amount of wilt and greatly increased the yields over no potash. Eight percent potash showed a slightly further reduction in wilt infection but no significant increase in yield. Applications of 6 and 12% of phosphoric acid in the fertilizer showed no significant differences in either yields or wilt infection.

Is Mopping Necessary to Control Boll Weevil?

Experiments conducted at the Upper Coastal Plain Branch Station during 1940 question the value of presquare mopping of cotton with a 1-1-1 mix. These results tend to be in line with the fact that there are no carefully conducted and checked experiments under controlled conditions where more seed cotton was produced on an acre that had been mopped than on an acre that had not been mopped.

There seems to be no sound scientific reason why presquare poisoning will give control for the boll weevil. In the first place, under North Carolina conditions, some of the weevils come out of hibernation after the presquare period. In the second place, the damage that boll weevils do is apparently directly related to general weather conditions. If the weather is warm and there are heavy rains with high humidity early in the summer, the boll weevil population will increase rapidly and great damage will be caused; but if the weather is hot and dry, boll weevils are not able to breed rapidly and no damage or only slight damage is caused. Moreover, it is not possible to predict the injury that may be caused by boll weevil either on the basis of counts of the number of weevils that went into hibernation the previous fall or on the basis of the number that come out of hibernation in the spring.

About one year out of every five or six is a boll weevil year in Eastern North Carolina. The other years the weevil is not a factor in cotton growing. Therefore, any method of weevil control or no control at all would be successful four out of five, or five out of six years on the average. In 1940 when

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

there were no weevils, just as good yields of cotton were obtained from plots that received no treatment as from plots that were mopped three to eight times. It remains to be determined whether the results will be different in a real boll weevil year.

Cotton Strength Depends Upon Growing Conditions[1]

The strength of cottons is closely related to the arrangement of the cellulose within the fiber. Cellulose is composed of long molecular chains arranged in a parallel manner. Under the microscope can be seen lines or striations in the cellulose which represent the direction of these chains. These striations in the cellulose of a cotton hair are arranged in a spiral, like a coiled spring, and this spiral may vary in steepness. If the spiral is flat the cotton is weak; if this cellulose chain is arranged nearly parallel to the axis of the fiber, the stronger is the cotton. The angle which the spiral makes with the axis of the fiber can be measured by X-ray methods.

The steepness of the spiral structure of the cellulose and therefore the strength of the cotton varies with the variety of the cotton and with growing conditions.

In a study of 16 varieties of cotton that were grown at 14 localities over a period of three years in the regional variety experiments of the U. S. D. A. it was found that the arrangement of the cellulose varied with rainfall and average temperature during development of the bolls. The angle which the cellulose makes with the axis of the fiber was small during period of low rainfall and high temperatures; good strength fibers were produced. On the other hand, if the temperature was low and the rainfall high, the cotton showed poor strength.

High temperature and lack of rainfall, such as occurred during July 1940, produce stress conditions, including wilting and low moisture in the plant cells. It seems the angle which the cellulose spiral makes with the axis of the fiber varies with the moisture in the developing boll. High moisture produces a flat spiral and low strength; low moisture causes a steep spiral and high strength.

If stress conditions continue for any length of time during the growing season poor vegetative growth and low yield may result. More reasearch is required to find the best combination of factors which will give good strength and good yield of cotton.

Fiber Diameter More Important Than Length in Determining Spinning Quality of Cotton

Results from two crops of several varieties of cotton show that a smaller fiber diameter, a heavier fiber weight, and a longer staple length are associated with a higher yarn strength, a yarn property which cotton mill operators consider to be very important.

The experiments also show that cotton from some varieties makes stronger yarns than that from others. For instance, one variety having a staple length of one inch and a fine fiber diameter gave yarns approximately 11% stronger than those from another cotton showing the same staple

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

length but a coarser fiber diameter. Yarns from the former variety were also about 11% stronger than those from another variety showing a longer staple length, 1 3/32 inches, and a coarser fiber. Cotton from the first variety would sell for the same price on the markets as that from the second, while cotton from the third variety, having a longer staple length, would bring about five dollars more per bale than either. The results seem to indicate that length of staple is being overestimated on cotton markets as a factor in spinning quality. It is probably that "fineness" as measured by width of fiber is more important than length. It appears that the present standards for the evaluation of cotton prices are inadequate.

The tests also point to the fact that seasons significantly influence certain fiber properties in varieties and also the strength of yarns. Yarns from the 1932 crops were considerably stronger than those manufactured from the 1934 crop.

Cotton Held by Farmers Inadequately Stored[1]

Improper handling of cotton by farmers is costly, according to a recent study of cotton marketing practices. Approximately 52% of the cotton in the Coastal Plain Area of North Carolina is stored on farms; 31% at gins; and only 3% in warehouses. Practically all of the cotton on farms and at gins is usually left lying on the ground exposed to the weather. This practice exposes the cotton to the sun, wind, and rain and causes a deterioration of the lint commonly called "weather damage." When cotton handled in this manner is offered for sale, the buyer inspects the cotton and makes allowance in price to take care of the damage. Cotton, not sold as ginned, should be stored in a place where it will be protected from the weather and from the moisture of the ground.

Trend in Grade and Staple of North Carolina Cotton[1]

The average grade of cotton in North Carolina declined each year from 1933-34 to 1939-40. During the year 1939-40 the average grade of cotton produced in the state was slightly above Strict Low Middling in grade. This is in marked contrast to the period from 1928-29 to 1935-36 when the average grade was Middling and above. The most probable reason for this decline in grade is the defective manner in which cotton is picked and handled and the bad condition of the cotton when carried to the gin. The average staple length of cotton, on the other hand, has steadily increased. In 1928-29 the average staple length of cotton produced in this state was slightly longer than 7/8 inch. In 1939-40 the average length was over one inch. This improvement in length is due largely to farmers planting seed of improved varieties that will produce lint having a staple of one inch and longer. During this twelve-year period farmers have become increasingly aware of the value of planting varieties that will produce cotton having a staple of one inch and longer but have failed to realize the downward trend in grade for the past seven years and its effect on the market value of cotton produced.

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[1]Cooperation: Agricultural Marketing Service, U. S. Department of Agriculture.

Pastures and Forage

Lime, Phosphate and Controlled Grazing Essential for Good Pastures in Piedmont and Mountain Areas[1]

Limestone and phosphate are the first essentials in permanent pasture improvement in Western North Carolina. Numerous pasture experiments throughout this area of the state have shown that limestone and phosphate increase the thickness of the sod, bring in legumes and bluegrass, cause bigger yields of high protein grass and lengthen the grazing season.

Typical results of pasture improvement in Haywood County are shown by the graphs in Figure 2. The vegetation on the unfertilized plot covered 62% of the ground; over half of this vegetation was weeds and undesirable grasses. Applications of phosphate increased the cover to 76%; the chief effect of phosphate was on the bluegrass and white clover. Lime increased the total vegetative cover to 79%; it mainly affected the growth of lespedeza although bluegrass and white clover were also benefitted. Lime and phosphate together increased the total cover to over 90%; two-thirds of this vegetation consisted of bluegrass, lespedeza and white clover.

The appearance of bluegrass, lespedeza and white clover in the pasture as a result of fertilization almost doubled the amount of crude protein produced per acre; total yields of grass were increased by about 70%. Nitrogen is needed to produce good forage with a high protein content. Lespedeza and white clover provide the nitrogen for the bluegrass. Since they contain relatively large amounts of nitrogen the total protein content of the forage increases.

Phosphate added on the basis of 400, 600, and 800 pounds of 16% superphosphate per acre every three years have produced beneficial results. The experiments have not been carried long enough to determine which of these rates will prove the most economical. A one-ton per acre application of limestone, however, has proven more economical and efficient than two tons. Therefore, farmers may expect more returns from applying two tons on two acres rather than on one acre.

Other experiments have indicated that intense grazing during one season not only reduces the total yield of grass for that season but also causes bluegrass and legumes to disappear. A thin sod composed primarily of weeds and undesirable grasses is the final result. Poor management of pastures may nullify the beneficial results of liming and fertilization.

Experiments in Ashe County have demonstrated that lime and phosphate increased the carrying capacity of the pastures for dairy cows from 54 cow days per acre to 117 days per acre. The total digestible nutrients per acre were doubled by proper fertilization. In a dairy cattle pasture experiment at the Mountain Branch Station near Swannanoa, fertilization increased the carrying capacity from 81 to 158 cow days per acre.

Legumes Benefit Grasses in Coastal Plain Pastures

In experiments started at Smithfield in 1937, lespedeza has demonstrated its ability to increase greatly the yield and nutritive content of pasture

[1]Cooperation: Tennessee Valley Authority.

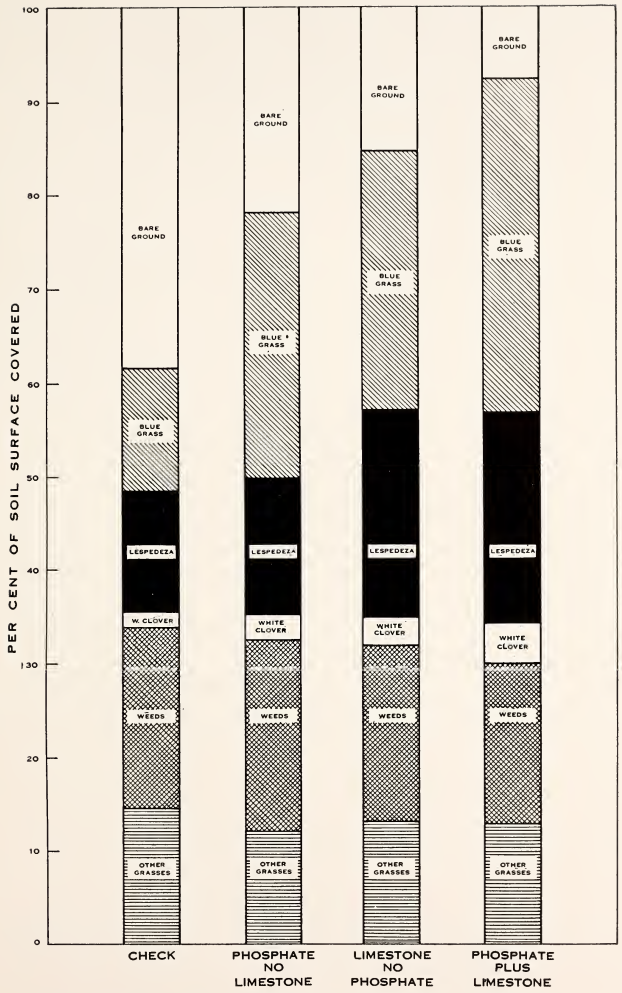

Figure 2.—Effect of Limestone and Phosphate on the Type of Plants in Pastures.

herbage when grown with Dallis, Carpet or Bermuda grass in the Coastal Plain. For all fertilizer treatments, except those which included the application of nitrogen, the yield obtained from a mixture of lespedeza with each of these grasses was more than double the yield from a pure stand of the grass. The total lespedeza in the Dallis, Carpet or Bermuda sod was increased by mineral fertilizers, but greatly decreased by the addition of nitrogen.

The season of the year and the species present have been far more effective than soil treatment in changing the chemical composition of the herbage. The phosphorus, calcium and protein contents were much lower during the summer and fall than during the spring. The presence of lespedeza in the sod has increased the phosphorus and added from 50 to 100% to the calcium and protein content of the herbage, in certain cases. The application of mineral fertilizers has added to the quantity of protein and minerals present by increasing the percentage of lespedeza, but has had little direct effect on the chemical composition of the various pasture species.

When all seeding mixtures are considered, nitrogen was the only fertilizing material that produced a significant increase in yield during 1938, but all treated plots were significantly higher than plots with no fertilizer treatment in 1939. Nitrogen produced a significant increase over the mineral fertilizers; limestone did not significantly affect the yield.

Nitrogen has been the only fertilizer which has caused significant differences in the yields of pure stands of Dallis, Carpet or Bermuda grass. Mineral fertilizers did not increase the density of the Dallis or Carpet grass sod, the increase of Bermuda with this treatment was only slight. Approximately 50% of the total dry weight of Dallis herbage consisted of seed heads except when the grass had been fertilized with nitrogen or grown in association with lespedeza.

How Closely Can Soybeans Be Grazed?

Preliminary defoliation studies on soybeans indicate that by careful grazing, high forage yields may be obtained and enough seed matured to plant the crop next year. Removing all but 3 leaves per plant every 20 or 30 days, or removing all leaves every 30 days gave the highest leaf yields. Removing all leaves every 10 or 20 days was too severe and materially reduced the total yield. Removing all but 6 leaves every 30 days was not as efficient as the more frequent treatment and gave lower total yield. The treatments giving highest leaf yields also gave high seed yields. These studies suggest that soybeans can be grazed until most of the leaves are removed, then allowed to regrow for about 30 days when they can be regrazed.

Do Your Soybeans Shatter?

Probably 30% of the soybean seed produced in North Carolina is never harvested. Since such a large part is lost through shattering and inefficient harvesting, the logical remedy for such a condition is the use of a high yielding, non-shattering variety. Data from variety tests at the Blackland and Lower Coastal Plain Branch Stations indicate that such a variety is available commercially at the present time.

Wood's Yellow has shown exceptional yielding ability in the Coastal Plain area when compared with old stand-bys such as Mammoth Yellow, Tokyo, and Herman. Part of this high yield is due to the fact that practically all the beans produced are harvested. In addition to producing more beans per acre, this variety affords the grower a little more time in which to harvest the crop without so much danger of losing the seed.

At the Lower Coastal Plain Branch Station the Palmetto variety has shown considerable promise. Although it has not yielded quite as much seed as Wood's Yellow, it is a much better hay type, producing a high tonnage of good quality hay. It shatters less than the commonly known varieties, but slightly more than Wood's Yellow.

Fig. 3.—Symptoms of mosaic on cowpea leaves. Middle, leaf from healthy plant; left and right, leaves from diseased plants.

The Clemson variety has not shown up well in Eastern North Carolina. It shatters as much as Mammoth Yellow and yields less than Herman. No yield tests have been made in the Piedmont in the past few years, and hence no actual comparative data are available for that area. However, most farmers who have tried the Clemson there have given it a favorable report. Like Palmetto, it may be classed as a semi-hay type and it gives a sufficient yield of seed to make it suitable as a dual purpose variety.

Mosaic Diseases Often Present in Cowpea Fields

If you find in your cowpea fields a number of plants with leaves that are wrinkled and show a mottling of light green and normal green color, it is

probable that these plants have the mosaic-streak disease. Young plants that become diseased are often killed, but if not killed are usually more or less retarded in growth. If the plant survives the first shock of disease and continues to grow, it usually then shows only wrinkled and mottled leaves for the rest of its natural life. Field observations indicate that the disease is seed-borne, but greenhouse tests lend only feeble support to this hypothesis. The disease has been transferred to soybeans and to certain varieties of garden beans. It does not spread readily from plant to plant in the absence of insects.

Peanuts

Copper-Sulfur Dusts and Copper Sprays Control Peanut Leafspot

Results of three years of experimental tests show that copper-sulfur dusts, ranging from 5 to 20 parts of copper and 95 to 80 parts of sulfur, and certain copper sprays, including Bordeaux mixture and cuprous oxide spray, have consistently given practical control of peanut leafspot diseases as well as economical increases in the yields of both nuts and hay. The most effective and practical schedule to follow in the application of these fungicides to peanuts is to make four applications at two-week intervals beginning between July 1 and 10. Such treatments have produced increases in yields averaging about 500 pounds of peanuts and 800 pounds of hay per acre, at a cost of about $5.00 per acre, including both materials and labor. The approximate value of the increased yields of peanuts and hay per acre is $15.00. Studies on the efficiencies of different fungicidal materials in the control of peanut leafspots have not progressed to the point that definite efficiency values can be given to the various materials under study.

Sulfur Dust Controls Peanut Leafhopper

Experiments conducted during 1940 on the Upper Coastal Plains Branch Station have shown that a mixture of 30% pyrethrum diluted with 70% sulphur effects excellent control of the peanut leafhopper, the most serious insect pest of peanuts in this state. Experimental plots dusted with this mixture gave an increased yield of 19% nuts and 55% hay over plots not dusted. Counts of leafhoppers on the plots showed that there were less than one-tenth as many on the plots dusted with sulphur as on those not dusted.

Dolomitic Limestone Gives Consistent Economic Returns on Peanuts

Dolomitic limestone applied in the row at planting time has given the most consistent economic returns on peanuts. These results have been obtained over a period of three years on five different soil types. The average net profit from 21 fields was $1.51 per acre with 76% of the fields showing an economic return. The practice of applying gypsum on the foliage at blooming time has given some outstanding increases in yield but on the average does not show up as well as lime; 76% of 21 fields gave an economic return from the use of lime in the row and 56% of 25 fields gave an economic return from the use of gypsum on the foliage. The average net return was $1.51 for lime and $1.57 for gypsum.

Potash and combinations of potash and phosphate, with and without lime or gypsum, increased yields on the average. The economic return from fertilization, however, is an individual field problem.

The use of iron, manganese, boron, copper, and zinc has not produced beneficial effects on the yields of peanuts, with the possible exception of manganese. The increases produced with manganese were not outstanding enough to be significant.

Breeding Peanuts for Quality and Yield

Numerous field experiments were conducted during 1939 and 1940 to find high yielding varieties and strains of peanuts that are also resistant to rot diseases. An advanced test was conducted on 16 varieties and strains of peanuts at the Upper Coastal Plain Branch Station in 1/40 acre plots and on 20 strains in smaller plots at 6 outlying points during these two years. At an average for these 14 tests, N. C. Selection 4 (Virginia Bunch type) ranked first in total yield, with a small runner type second; both of these two strains showed a rather wide range of adaptation. Jumbo runner strains, on the other hand, were found to be limited in their range of adaptation. This type produced a significantly higher yield than strains of Virginia Bunch at only one location.

In these tests Valencia peanuts have been found more susceptible to root rot diseases than strains of Virginia Bunch or Jumbo Runner types, as measured by percentage of plants dying during the season. Valencia and Spanish types, however, produce pods with firmer-textured shells and less disease than do the larger types. This is partly due to the earlier maturity of these types; it is possible that this firmer-textured shell can be transferred to the larger types by breeding.

One hundred and sixty-five new introductions secured from the Division of Horticulture and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, have been grown during these two years in a search for more resistant material, but none of these have been equal to locally grown strains in yield and have not been found more resistant to disease. Similar trials have also been conducted with local selections, and with selections secured from hybrid material from Georgia and Florida.

Hybrids between the principal peanut types: Virginia bunch, Jumbo runner, Valencia and Spanish, made in 1938, are now in the fourth generation. Only 120 out of 5,000 third-generation plants were selected to carry into the fourth generation. This indicates the low frequency of occurrence of good type nuts in segregating material when widely varying parental types are used. Several small populations of back crosses, using the large type parent, indicate that this method of breeding has many possibilities for peanut improvement.

Small Grains

Improved Varieties of Winter Barley Now Available to North Carolina Farmers

Barley, often referred to as "winter corn," is becoming more and more popular as a feed grain in North Carolina. This is especially true in areas where it is desirable to substitute soil conserving for row crops and where it is necessary at the same time to maintain the supply of feed grain.

The two bearded strains of barley, Davidson and Randolph, which were first released to farmers on a trial basis in 1938, have continued to make relatively high yields in tests at the Piedmont Branch Station, Statesville, during the past two years.

During a 9-year test these two strains outyielded Tennessee Winter, the standard bearded barley in this region, with average yields as follows: Tennessee Winter, 33.6; Randolph, 38.0; and Davidson, 40.6 bushels. This is a percentage increase of 20.8 for Davidson.

The first hooded strains of barley were distributed in the fall of 1940. Hooded selection 23, named Iredell, has produced more grain than has Tennessee No. 6 Hooded in seven of the nine years it has been in nursery trials. The average yields for these two strains have been 33.4 and 28.8 bushels, respectively. Iredell will be used primarily as a forage barley.

In addition to their yielding ability, another reason for the growing popularity of two of these barleys is their resistance to smut. In inoculation studies carried on during the past four years, Iredell and Davidson have been found highly resistant to Brown loose smut (Ustilago nuda) collected locally and to several races of Black Loose (U. nigra) and covered smut (U. hordei).

Cold and Disease Resistant Oats Being Developed

Winter-hardiness is considered of first importance in breeding oats for fall-sowing in the Piedmont area of the State; smut and rust resistance are second. Near the coast, however, rust often takes a heavy toll and resistance to this disease may be of more importance than winter-hardiness in that area.

Experiment Station workers working in cooperation with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. D. A., are attempting to overcome these difficulties by combining the winter-hardiness of Lee and certain other hardy varieties (Lee has been the highest yielding variety at Statesville over a 15-year period, due in large measure to its hardiness), with the rust and smut resistance of Victoria.

A number of selections from crosses of Lee x Victoria and Hairy Culberson x Victoria were obtained in 1936 and others have been made locally. During the past three years 38 of these selections have been on test at the Piedmont Branch Station, Statesville, and 11 have produced yields equal to or superior to Lee. Winter-hardiness tests conducted at Swannanoa indicate that very few if any of these are quite as hardy as Lee, though two of this group have shown as good survival as Lee in the Uniform Eastern Winter-

Hardiness tests conducted by the Division of Cereal Crops and Diseases in 1938-39 and 1939-40.

Three of these varieties, an early, a mid-season and a late strain are being multiplied for possible release in 1941.

Carala, a New Wheat for North Carolina

Carala, a selection from Alabama Blue Stem, has been the highest yielding variety at the Piedmont Branch Station, Statesville, as an average for the past eight years. During this period it averaged 14.4% more than Nittany, the check variety, and 7.2% more than any other variety in the tests. Carala also produced the highest average yield of any named variety in each of three tests conducted in the Coastal Plain for the year 1939-1940.

This new variety is not resistant to smut or leaf rust, but is early and usually escapes severe rust damage. It is recommended for the southern Piedmont and the Coastal Plain areas.

Tobacco

Proper Fertilization Increases Yield and Quality of Tobacco[1]

Investigations in the fertilizer requirements of flue-cured tobacco at the Tobacco Branch Station near Oxford indicate that mixed nitrogen including both nitrate nitrogen and ammonia nitrogen give better results than when the nitrogen is derived from a single source. Also that soybean meal is as good a source of nitrogen as cottonseed meal or other individual sources. There are definite indications that too much nitrogen is objectionable. Twenty to 30 pounds of nitrogen per acre properly balanced with the other elements are about the maximum that can be profitably used except on a few of the light sandy loam soils, where as much as 40 pounds per acre may be used.

On the average tobacco soils, such as the Durham, Granville, Appling, Enon, Creedmoor, etc., 80 to 100 pounds per acre of P_2O_5 appear to be sufficient to properly mature the leaf. On the Norfolk series of soils, slightly less will meet the requirements.

On practically all soils 60 to 120 pounds potash (K_2O) per acre will increase the yield and value. Higher rates do not give corresponding increases in value.

The heavier rates of potash improve the quality of the cured leaf and also seem to increase the plant's resistance to leaf spot diseases. The results at Oxford do not indicate a lowering of quality even when excessive applications are made such as 240 to 300 pounds K_2O per acre. There are indications, however, that when the rate of K_2O is increased above 60 pounds per acre that the sulfur should likewise be proportionately increased.

Calcium and magnesium are essential. There are very few instances of calcium deficiencies, no doubt due to the wide use of superphosphate in all commercial fertilizers. Magnesium deficiency is not so noticeable as a few years ago although it may quickly become serious if omitted from the fertilizer mixture.

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[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

A small amount of chlorine is still very desirable in the mixture as experimental data indicate. There have been very few definite indications that boron deficiencies are as yet serious in the average tobacco soils in this area.

Yield and Quality of Tobacco Related to Correct Spacing and Topping[1]

The spacing of plants in the field and the heights and time of topping have an important bearing on both yield and quality of the tobacco leaf. In investigations carried on at Oxford, the tobacco has been planted in 4-foot rows and spaced at intervals of 12, 18, 24, and 36 inches; 800 and 1200 pounds of a 3-8-6 fertilizer per acre were used. The results indicate that the leaves are too small when tobacco is planted 12 inches in the row. Spacings of 18 and 24 inches appeared to be the most desirable. The tobacco usually was coarse, large and of poor quality when planted 36 inches in the row. In all cases, tobacco should be topped leaving 18 to 24 leaves to the plant. The top or terminal bud should be broken out as soon as it gets large enough; topping may then be done without injury to the top leaves left on the plant.

Proper Plant Bed Management Produces Healthy Tobacco Plants[1]

Investigations at Oxford in tobacco seed-bed management have definitely proved that narrow beds, 6 to 10 feet in width, are not only better for the control of blue-mold but also produce more strong, healthy plants per square yard than the large square or rectangular bed; moreover, narrow beds are more economical. In all the fertilizer tests, 1½ pounds of a 4-8-3 mixture per square yard gave a better stand and more plants than applications of 2 pounds or more. This fact indicates that more fertilizer than is necessary is being used on most plant beds.

Blue mold can be controlled by spraying with a copper oxide oil mixture or by treating with paradichlorobenzene gas. The gas treatment is effective if used two or three nights a week under cotton sheeting. Rates of 3 pounds under dry cover and 1½ pounds under a wet cover, per 100 square yards are sufficient.

Nitrogen and Phosphate Fertilizers Help to Decrease Granville Wilt of Tobacco

Although crop rotation is found to be the best method of reducing the severity of Granville wilt, field plot experiments during 1939 and 1940 have indicated that nitrogen fertilizers also aid in decreasing the disease. Applications of 100 pounds of nitrogen per acre as urea reduced wilt by 54%, as nitrate of soda by 51%, as sulfate of ammonia by 36%, and as blood meal by 5%, as compared to the amount of wilt on plots receiving a normal rate of nitrogen. The same treatments reduced black shank injury of tobacco as follows: urea, 35%; sulfate of ammonia, 18%; nitrate of soda and blood meal, less than 1% each.

The favorable influence of nitrogen on the reduction of wilt has been shown also in sand cultures in the greenhouse. Two varieties of tobacco, White Stem, which is a susceptible variety, and 79a, a resistant variety,

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

were grown on sand in which the concentration of nitrogen, phosphorus, and potassium were varied; in the case of some cultures, small amounts of copper, manganese, boron, cadium, and cobalt were added. The Granville wilt organisms were inoculated into the stem as well as into the soil. The tobacco variety 79a was very resistant toward attack, irrespective of treatment, whether the stem or sand were inoculated.

The White Stem variety gave the following results with sand inoculations: 52% of the plants wilted where no nitrogen was applied, and 28% wilted with nitrogen additions. With a low rate of nitrogen 36% of the plants wilted, and only 20% with a high rate of nitrogen. Minor elements did not cause a reduction in wilt. Fifty-three per cent of the plants wilted where no potash was applied and 27% wilted where potash was added. The percentage of wilt for both the low and high rates of potash was 27. The corresponding figures for phosphorus were 48, 21, 38, and 14%. These results indicate that a nutrient balance, particularly with respect to nitrogen and phosphorus, is an important factor in the reduction of the disease. It should be remembered, however, that the beneficial effects of nitrogen on the reduction in Granville wilt may lead to harmful influences on tobacco quality. It will be necessary to investigate this phase of the problem further.

Crop Rotations Essential for Combating Granville Wilt[1]

Four years' results from crop rotation experiments near Creedmoor have indicated that corn, soybeans, redtop, cotton, small grains, and lespedeza, when grown in rotation with tobacco, help to reduce Granville wilt on infested soil. Five-year rotations were more effective than two or three-year rotations. Rotations of natural weed fallow gave poor control. Bare fallow rotations reduced disease severity but were much less effective than rotations of crop plants. Tobacco following tobacco was a complete loss, whereas tobacco following four-year rotations of corn and redtop produced yields worth $125.000 and $120.00 per acre, respectively.

Root Knot (Nematodes) of Tobacco Controlled with Good Crop Rotations[1]

Experiments at the McCullers Tobacco Branch Station with nematode resistant or immune crops, such as peanuts, velvet beans and crotalaria have shown that control of root knot can be obtained in two-year rotations with tobacco. Susceptible crops, such as corn and cotton, give very poor control in a two-year rotation; better control is obtained when these crops are grown in a three-year rotation. In three-year rotations where a susceptible and resistant crop are grown, best results are obtained where the most resistant crop precedes the tobacco. For example, cotton-peanuts-tobacco gives much better control than peanuts-cotton-tobacco.

Early transplanting has shown a marked increase in yield and value per acre over medium and late, especially late, but there has been no consistent difference in degree of nematode infestation. Ridge versus flat cultivation has shown a slight difference in yield and value per acre in favor of the ridge method. There has been no difference in nematode infestation.

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[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

Tobacco Mosaic Virus Lives in the Soil

The quality and selling price of the cured tobacco leaf is markedly reduced by the mosaic disease. Since, as a rule, no part of the diseased plant is killed, and diseased leaves are harvested and cured along with healthy leaves, farmers are not generally aware of the losses caused by the disease. It has been found that the virus which causes this disease may live in the soil for periods varying from a few months to a few years, the time depending upon conditions in the soil. Fortunately it does not readily enter the leaves of plants through the root system. But plants do readily become diseased when leaves rub on soil containing the virus. Here again nature comes to the aid of the farmer, however; for when the top layer of soil becomes air dry, the virus in it is soon inactivated. The leaves rubbing the soil are then safe from infection until fresh soil is again thrown up in cultivation. The disease is spread rapidly in the field by indiscriminate handling of diseased and healthy plants in topping and suckering.

1940 TOBACCO

Fig. 4.—N & K Plot in regular fertilizer series of plots Field No. 3, Oxford, N. C. Foreground limed at the rate of one ton per acre of Dolomite broadcast in 1922, 1925 and 1928, a total of three tons per acre. No lime applied since 1928. Rotation tobacco, oats, soybeans, wheat.

Flue-curing of Tobacco Improved by Correct Air Control[1]

Experiments at the Tobacco Branch Station have definitely established that a large volume of air is necessary for curing out the tobacco and pre-

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

venting "scalding" or mottling of the leaf, and that preheated air is more desirable than cold air. When warm air comes in contact with the tobacco it does not tend to explode the sap cells in the leaf, the cause of scalding.

The use of conditioned air for curing is being studied in a large barn, regular size, which is equipped with a furnace and coal stoker with air pipes running through an insulated jacket and then to the barn. By this method no direct fire is used inside the barn, only preheated air. A connection is made so that recirculation of heated air can be used when desired. This method is quite satisfactory and with some modifications will not only be practical but will be economical. The total fuel cost was reduced 25 to 40% over the cost of wood and a better cure was effected. The time required by the operator may be reduced about half, but the time of the curing of the leaf is not materially reduced.

Tobacco Not Purchased on Government Grade

Flue-cured tobacco is not purchased on government grade. This is evident from an extensive study just completed involving 9 million pounds of tobacco all of which carried the government and buyer's grade. Although each company uses its own private system of grades, it was possible to measure the extent to which private grading agreed with federal grading of tobacco. Analysis of the data indicates approximately 68% agreement with the federal grading by one major company, 56% by another company, and 52% by a third. Not only is this true, but grading by both federal graders and company buyers is far from exact. Analysis of a sample of tobacco lots graded twice the same day by federal graders and company buyers indicated that less than 50% of the lots were placed in the same grade on the second inspection as on the first.

HORTICULTURAL CROPS

Apples and Peaches

Better Control of Apple Diseases Sought

Experiments were started in 1940 to design a more effective program for the control of apple diseases in North Carolina orchards. The need for such a program is emphasized in the fact that apple diseases are responsible for an average annual reduction in the yield and quality of the crop approximating 20%.

These investigations involve: (1) a study of the effectiveness of spray applications in relation to parasite development and weather conditions; (2) measurement of the effectiveness of different concentrations of spray materials in relation to the control of organisms parasitic on apple and in the prevention of spray injury; and (3) measurement of the effectiveness of different fungicidal materials in the control of apple parasites, especially

the bitter rot, black rot, and blotch parasites, and in the prevention of spray injury. Work along these lines has been started in seven orchards (6 in the Mountain area and 1 in the Piedmont).

Results of the tests conducted in 1940 show a high degree of scab control for all spray applications beginning with the prepink and including the 4th cover (totaling 8 applications). The critical period for scab development extended from the prepink through the petal fall stage, as evidenced by primary ascospore discharge during this period and by relatively high percentages of scab on both fruit and foliage where the prepink, pink, bloom, or petal fall applications were omitted. The 3rd and 4th cover sprays were most important for bitter rot control. Weak concentrations of spray materials (Lime-sulfur 3 qts. to 50 gals. of water, and Bordeaux mixture 1,3,50) throughout the season were slightly less effective in controlling scab and bitter rot than usual concentrations (Lime-sulfur 5 qts. to 50 gals. of water and Bordeaux mixture 2-4-50), when the change to Bordeaux mixture was made at the 1st cover spray. Weak lime-sulfur carried through the 2nd cover spray and followed by usual concentrations of Bordeaux mixture was equally as effective in scab and bitter rot control as usual strength materials throughout the season.

Hormones Prevent Premature Apple Drop

Premature dropping of apples from healthy trees before maximum color and quality have developed has long been a problem confronting the fruit grower. By using a mixture of naphthalene acetic acid and naphthylacetamide this loss to the grower may now, in large measure, be prevented.

On sprayed trees in a Limbertwig orchard in Wilkes County, only 15% of the fruit had dropped at harvest time while on unsprayed trees 40% of the apples had dropped prematurely. The spray was applied on October 16 and the fruit picked and counted on November 7.

Bonum, Delicious, Stayman and Winesap were sprayed at Swannanoa. In order to determine the time of application difference, sprays were applied on August 26 and again on September 3. The August 26 spray was not effective but the September 3 application reduced the percentage of drop on Bonum from 7% for the unsprayed to 4% for the sprayed trees; and on Delicious the figures were 16.4% for the unsprayed as against 10.9% for the sprayed trees. Both of these varieties ripen earlier than Winesap and Stayman. From the results in 1940 it is indicated that applications were mad too early on all four of these varieties.

This work emphasizes the fact that sprays should be timed in relation to the ripening date of each variety, and should not be applied until a few of the sound apples have droped from the tree.

Better Roots for Peach Trees

Nematode, or root knot, is a serious problem on peach trees grown in coarse sandy soils. No control is now known except to bud trees on root stocks which are known to be resistant to root knot.

Seed of the Shalil peach have proven to be resistant to the nematode but they are hard to obtain from other sources and the tree is a shy bearer under conditions prevailing in North Carolina.

In order that stocks might be produced from the Shalil, it was necessary to evolve some method whereby cuttings could be rooted. It was found that by soaking cuttings overnight in solutions of indole-butyric acid (1 mg. per 100 cc. of water for softwood cuttings, and 4 mg. per 100 cc. of water for hardwood cuttings) it was possible to root 95% of the cuttings in a sand propagating bed where optimum conditions were maintained.

The use of this method should give rapid multiplication of this valuable stock, true to name.

Fig. 5.—Rooted cuttings of the Shalil peach after two weeks in the propagation bench.

Crab Grass Stunts Young Peach Trees

Studies of the growth of young peach trees and of crab grass in large tanks of typical sandhill soil have shown that crab grass used 10 times as much moisture as young peach trees during the first growing season. The peach trees utilized only 10% as much soil water as the crab grass during the first year and 65% as much during the second year. The roots of the crab grass extended to a depth of 5 feet and during periods of

light rainfall, or drought, a stand of grass was able to utilize all the available soil moisture within as short a period as 30 days.

Young trees growing in direct competition with crab grass over a two-year period were severely stunted. Trees stunted by a grass cover during the first year grew rapidly the second year under a system of clean culture. Trees grown in clean cultivated tanks the first year made a fair growth in competition with crab grass the second year. Crab grass competition reduced top and root development, caused a premature loss of leaves, and a reduction in the number of fruit buds.

Crab grass is a naturally occurring summer cover in cultivated areas of the Sandhills and is a persistent and vigorous volunteer in the peach orchards of this region. If it is not effectively controlled, it may severely damage young peach trees by reducing soil moisture and plant nutrients.

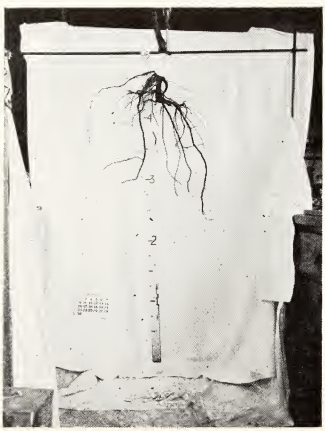

Fig. 6.—Root system of peach tree grown in direct competition with unrestricted crab grass cover.

Fig. 7.—Root system of peach tree grown without competition from crab grass cover.

Bacterial Fruit and Leafspot Disease of Peach Related to Nutrient Deficiencies

A correlation between nitrate fertilization and susceptibility of peach to the bacterial fruit and leafspot disease has been demonstrated in experimental tests for the past two years. These tests are located in five orchards in the Sandhill area of the state. The nitrate has been applied to the trees in small amounts at frequent intervals during the growing season. The seasonal rates of application have ranged from 3 to 12 pounds of nitrate of soda per tree. Bacterial spot was severe on the foliage in 1939 and mild in 1940 on trees which received no nitrates, compared to mild in 1939 and negligible in 1940 on trees which received nitrate. Both seasons defoliation

was premature and heavy on the low nitrated trees, as compared to practically no premature defoliation on the heavily nitrated trees; this was evidently related to differences in injury by the leafspot parasite. Chemical analyses of foliage have shown a greater absorption of elements other than nitrogen by the treated trees. Hence, the resistance of highly nitrated trees may not be due to greater absorption of nitrogen alone.

Growth responses have been extraordinary from the applications of nitrate when measured in terms of (1) length of terminal growth, (2) weight of terminal growth, and (3) set of fruit buds.

Several inert copper compounds, at strengths of 2 to 4 pounds to 100 gallons of water, applied at 7- and 14-day intervals during May, June, and July, 1939, reduced bacterial fruit and leafspot infections only slightly. Severe injury, particularly evident on the foliage and twigs, was caused by these materials. This injury was not prevented with zinc sulfate in the mixture, and it became more prominent as the season progressed.

Peach Tree Borer Easily Controlled

Experiments carried on during 1939 and 1940 in the Sandhill area have shown that the use of ethylene dichloride emulsion is a better method for controlling the peach tree borer than Para gas. By the use of this new material, the number of borers was decreased, on the average of 8 to 14 per tree to only 1 to 3 borers per 10 trees. The same experiments showed that it is necessary to mound the trees after treating with the ethylene dichloride emulsion but that the mound does not need to be large; 2 or 3 shovelfuls of soil were just as effective as 16 shovelfuls. The experiments last year indicated that patting the mounds was a waste of time and energy, and that it may actually decrease the efficiency of the treatment. Approximately 100 trees, ranging in age from 1 to 7 years and representing 5 different varieties, were treated with ethylene dichloride emulsion during the fall and winter of 1939-1940. Only 1 tree of this number was injured and this tree was so badly infested with peach tree borers that the insecticide came in direct contact with the living inner bark. However, the injury was only slight and probably not worth considering from the practical point of view.

Ethylene dichloride should be used strictly according to the directions of the manufacturers as printed on the label.

Small Fruits

Can Raspberries Be Grown In the South?

People in the deep South have not been able to grow raspberries in their gardens because, until recently, no varieties have been adapted to southern conditions.

By crossing American varieties with species introduced from Japan and China, both red and black types of raspberries have been developed that are as large as three-quarters of an inch in diameter. In addition, the region in which these fruits will grow has been extended several hundred miles south and east.

Further breeding, or back crossing, has reduced the Asiatic blood, thereby improving quality, but has not affected disease resistance, vigor, or adaptability to southern conditions.

Fig. 8.—Large-fruited red raspberry hybrid. (Vigor, disease resistance and productiveness from one-fourth Asiatic parentage.)

Wild Blueberry Used in Breeding[1]

The wild blueberry growing at the higher elevations in Western North Carolina has long been noted for its high flavor, good blue color, productiveness, and large size. During the summer of 1940 several plants of this species having superior characteristics were located in that area. One form was discovered near Jonas Ridge, N. C., which had berries as large as a dime, an unusually large size for a wild blueberry. Other forms with desirable characteristics were located on the ridges of Grandfather Mountain and adjacent peaks.

These plants will be propagated and used in the cooperative breeding program of the N. C. Experiment Station and the U. S. Department of Agriculture. Since the Western North Carolina form has the same chromosome number as the rabbiteye blueberry of Western Florida, these two species will be crossed in an effort to combine the large fruit size, vigor, and disease resistance of the rabbiteye with the high color, flavor, hardiness, and upland habit of the mountain type. Selected plants will also be propagated and

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture; and Soil Conservation Service.

fruited at the higher elevations in Western North Carolina in the hope that some of these wild selections may prove worthy of introduction as named varieties for that region.

The wild blueberry of Western North Carolina provides the mountain people with an important food product and a welcome source of cash income. The bulk of the fruit is made into jelly, jam, and pie stocks for home consumption, but large quantities are also sold to local canneries or as fresh fruit at nearby markets. The prevalent price varies from 25c to 50c per gallon, depending upon quality, current demand, and the crop available. The excellent quality of the fruit, the productive habit of the plant, and the ability to grow on large areas of waste mountain land unsuited for many crops, makes the species highly valuable as a source of breeding stock in the development of superior varieties. Improved forms should add greatly to the income of a large number of farmers in the mountain area.

New Strawberry Introduced[1]

As a result of the cooperative breeding work of the North Carolina Experiment Station and the U. S. Department of Agriculture, a new strawberry was introduced in 1940 because of its high dessert quality, beauty, and large size. This new berry has been named Massey, in honor of Prof. W. F. Massey, who was the first horticulturist at the North Carolina Experiment Station and whose name was intimately associated with the development of horticulture in the early days of Experiment Station work.

The Massey is a midseason variety, ripening a week to 10 days later than Blakemore in Eastern North Carolina. Although it is consistently productive it is not exceptionally so. During 1939 and 1940 the 2-year average yield per acre was 248 crates for Massey as compared with 286 crates for Blakemore. Yield of U. S. No. 1 berries is usually high, and the berry averages larger than most varieties. During the 1940 season, No. 1 fruit averaged 50 berries per quart compared with 82 per quart for Blakemore.

The berry ripens to a bright red, and it holds its color, gloss, and flavor even better than Blakemore. The flesh is a light bright red, juicy, firm, and of high dessert quality. Its aroma is distinctive and pleasing. Because of its beauty, size, firmness, and high dessert quality it is a superior variety for the fancy trade. It is better than other varieties in that it holds its dessert quality for several days under conditions when other varieties do not. If it proves generally productive, it will set a new standard of dessert quality in a market berry.

The Massey is more vigorous than most varieties, and much more vigorous than Missionary and Klondike, as grown in Eastern North Carolina. The plants become very large, with many crowns, and the leaves are exceptionally large. The foliage has been freer from leaf spot than Blakemore, Missionary, or Klondike. It has leaf scorch in some seasons, but not as much as Missionary.

The Massey's pedigree contains superior germ plasm from Blakemore, Missionary, and Howard 17, three important varieties from the United States, as well as from Royal Sovereign, a high-flavored variety from England. It originated as a cross between U.S.D.A. 634 and Blakemore, made

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

in 1933 at the U. S. Plant Field Station near Glenn Dale, Md. U.S.D.A. 634 is a cross of Royal Sovereign and Howard 17. The Massey was among selections made in 1934 from seedlings taken to the branch station at Willard the previous year.

Number of Strawberry Leaves in Fall Determine Yield the Following Spring[1]

Records for three seasons on the relation of the number of leaves per plant in November to the number of flowers per plant the following spring indicate that the more leaves a plant has at the end of the growing season the greater will be the yield the following spring. Blakemore plants with 4.5 leaves on November 15 averaged 28 flowers per plant the following spring as compared with 47 flowers for plants averaging 7.9 leaves, 68 flowers for 12.6 leaves, 83 flowers for 17.3 leaves, and 100 flowers per plant for plants

Fig. 9.—In order to determine the effect of plant or soil treatments upon growth and production, strawberries from all plots are carefully weighed and graded at each picking.

averaging 22.7 leaves. The records were taken on plants in spaced beds, and comparisons were made between runner plants rooted in June, July, August, and September. The effect of age of plant seems to be mostly a matter of plant size as measured by the number of leaves per plant. The oldest plants produced the greatest number of leaves and flowers per plant, although the younger plants averaged more flowers per leaf. The data indicate that growers would do well to follow cultural practices designed to give medium to large plants at the end of the growing season. This means that runner plants shoul dbe rooted by not later than midsummer if possible.

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

Does the Preceding Crop Affect the Growth of Strawberries?[1]

The importance of the crop preceding strawberries is frequently considered a very important factor in determining the stand and growth of the strawberry crop. A most outstanding example is a field where strawberries followed six years of corn and soybeans. Preceding the strawberries, the field had been planted to alternating two rows of corn and one row of soybeans. The strawberries were planted over the old rows, after double discing. Two good rows of strawberries were obtained on the corn rows with practically no plants on the soybean rows. This problem appears to be localized, however, since growers in another section of the strawberry belt prefer soybeans as a crop to precede strawberries.

Two rotation experiments with cowpeas or Sudan grass followed by oats, followed by velvet beans, soybeans, sweet potatoes, snap beans or lespedeza preceding two years of strawberries have shown no significant differences between the effects of the preceding crop. These results indicate that bad effects following a given crop are probably local in nature.

Correct Fertilization Important in Strawberry Production[1]

Recognition of the fact that a double row of strawberries produces a larger yield of better quality berries than a matted row does not result in changing the common matted row because of the extra labor required in spacing the plants. The problem is then to apply the fertilizer to a matted row to produce the highest yields with the least fertilizer damage to the leaves and fruit bud.

Two years results indicate that the September application of fertilizer placed in bands to the side of the matted row does not benefit the plants in the center of the row as well as placing two-thirds of the fertilizer in bands to the side and one-third on top of the foliage, which is then brushed off of the leaves. Preliminary results indicate little difference between placing the fertilizer bands 2 or 4 inchs below the surface of the ground.

There is some question as to the correct time of applying fertilizers to strawberries and whether one application or a split application is more profitable. The distribution of the seasonal rainfall and the effect of early freezes appear to be the determining factors in the response to any particular time of application for any given year. Considering these uncontrollable factors and the danger of fertilizer injury from an early fall application, a split application, one-half in September and the other half in December or January appears to be the best practice for average conditions.

Liming Acid Soils Increases Strawberry Yields[1]

The production of strawberries on an acid soil (original pH of 4.8) has been increased 1199 quarts by liming. Lime was applied at the rate of 1, 2, 3, and 4 tons per acre at the time the plants were set (February, 1937). By November, 1938, 15% of the plants were dead on the plots receiving no lime; 11, 10 8 and 8% of the plants were dead where 1, 2, 3, and 4 tons of lime, respectively, had been applied.

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[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

The yields for the two years, after resetting all spaces where the plants had died, were as follows:

Tons of lime	YIELD PER ACRE			
	1938 qts.	1939 qts.	Average qts.	Increase qts.
0	2410	2772	2591	...
1	2441	3632	3036	445
2	2454	4259	3356	765
3	2707	4414	3560	969
4	3365	4215	3790	1199

The effect of the lime was greater the second year than the first; the average increase in yield was after all skips resulting from dying plants were replanted. The cost of replanting skips must, therefore, be added to the cost of production on the plots receiving no lime. The cost of 4 tons of lime at $3.00 per ton is a $12.00 investment for an average increase of 1199 quarts for the two years.

Truck Crops

New Irish Potato Gives Highest Yields[1]

Over a five-year period the Sequoia potato, a new variety introduced by the N. C. Experiment Station in 1939, produced an average of 347 bushels per acre compared with 224 bushels for Cobbler, 218 bushels for Katahdin, and 263 bushels per acre for Chippewa. During 1939 and 1940 the Sequoia has been further tested by cooperators in all sections of the United States as well as in Canada, Mexico, and Cuba. In general, reports from other sections bear out the North Carolina findings in that resistance to leaf hoppers and flea beetles is reported, and field resistance to late blight. Yields up to 600 bushels per acre have been recorded.

The high yielding ability of Sequoia is attributed largely to its resistance to leaf hoppers, flea beetles and late blight. It is estimated that leaf hoppers alone reduce yields of Irish potatoes from one-third to one-half in Western Carolina each year. The average yield for this area on all farms is between 90 and 100 bushels per acre.

The Sequoia was one of a family resulting from a cross between Green Mountain and Katahdin. The plant is extremely vigorous and the tubers smooth with slightly russet skin. Very large tubers have a tendency toward deep eyes in the bud end. Preliminary tests run in 1940 indicate that this condition may be overcome by closer spacing and reduction of the amount of fertilizer applied per acre. While data on cooking tests have not been

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

completed the variety has been given a rating of from fair to excellent by cooperators in other states. Due to late maturity it is recommended only for late producing sections. However, tests in the early belts of North Carolina, Virginia, South Carolina, and Louisiana are sufficiently encouraging for further trial. Plantings in Florida in the winter of 1939 led to a heavy demand for seed stock from growers in the Hastings section in 1940. Tests are being conducted in North Carolina and Virginia to determine the possibilities of this variety as a fall or second crop in the early belts.

Fig. 10.—Tubers of the new high yielding Irish potato variety Sequoia. Named and introduced in 1939.

Sequoia was named for the Cherokee Indian Chief "Sequoyah" who led his race out of the wilderness of ignorance by giving them an alphabet. While the name Sequoia directs one's attention to the giant trees in California and Sequoia National Park, the fact remains that he was a North Carolinian and one of her most famous citizens.

Tip-burn Resistant Lines of Lettuce Show Promise[1]

It is well known that lettuce varieties differ greatly in adaptability and resistance to tipburn. Since it has been shown by experimental work at this station and elsewhere that neither cultural practices nor fertilizers will control tipburn, the solution of the problem therefore would appear to be in the development of resistant varieties.

Crosses have been made between desirable market types and tip burn resistant types. Some of the progenies of these crosses, although they are not yet completely fixed lines, have shown superior tipburn resistance as compared with standard varieties and at the same time possesses desirable market qualities.

A marked difference in adaptability has also been noted. One selected line of a New York-Mignonette cross has performed excellently at Raleigh while it has been a failure in tests at Wilmington.

Increased Nitrogen Makes Better Grade Pickles[2]

A two-year fertilizer test indicates that increased applications of nitrogen improve the shape, grade, and color of pickling cucumbers. On plots receiving 800 pounds per acre of 4-8-4 fertilizer plus 100 pounds of nitrate of soda, only 17% of the cukes were graded out as misshapen compared with 40% of misshapen fruits on plots fertilized with 800 pounds of a 2-8-4 mixture and no additional nitrogen. On the low nitrogen plots the fruits were pale green when small and many of them turned yellow upon reaching dill size. Plots receiving normal amounts of nitrogen (800 pounds of 4-8-4 and 100 pounds of nitrate of soda) produced fruits of normal color. High amounts of nitrogen, represented by 800 pounds per acre of an 8-8-4 mixture plus 200 pounds of nitrate of soda, produced a further improvement in color and only 10% of the cukes were misshapen. Although the highest amounts of nitrogen gave further improvement in the color and grade of fruits, the increased value of the crop was not equal to the increase in cost of materials.

The taste and texture of both fresh and sour pickles made from cucumbers grown on the different plots did not reveal any differences due to fertilizer treatment, and pickles from all plots kept equally well. Even the highest amounts of nitrogen failed to produce any softening effect. Over 5,000 pressure tests on fresh cucumbers, commercial salt stock, and pickles showed no significant differences due to fertilizer treatment. Large variations in both the phosphoric acid and potash content of the fertilizer mixtures produced very little change in the quality of marketable fruit. In general, the data indicate that moderate to large applications of nitrogen will improve the color and grade of pickling cucumbers without producing soft fruit.

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.
[2]Cooperation: Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture.

Pasteurization Prolongs Shelf Life of Dill Pickles[1]

A promising method of preserving genuine dill pickles has been developed during the past two years through the cooperative efforts of the N. C. Experiment Station and the U. S. Department of Agriculture. By a suitable method of pasteurization shortly after completion of the curing period, the pickles retain their original crispness and characteristic flavor over a period of many months. Examinations at regular intervals over a one-year period showed that the bacteria in the pasteurized dills had been reduced to an insignificantly low number. In the unpasteurized lots a comparatively large number of bacteria persisted over a period of a year or more.

Genuine dill pickles are usually available only during the fall and early winter due to the difficulty of keeping them through the warmer part of the year. The introduction of satisfactory pasteurization is seen as a great boon to commercial pickle packers, especially in the South, and should make this highly prized product available the year around.

Leaf Diseases of Cantaloupes Controlled by Fungicidal Dusts and Fertilizers

Control of leaf diseases of cantaloupes with a fungicidal copper dust and a correlation between the degree of leafspot control with the dust and magnesium fertilization are shown in the results of two years of experimental tests conducted in Scotland County. In these tests suitably replicated plots received usual amounts of nitrogen and phosphate, but in some the magnesium and potash were omitted. Part of the plots which received the different fertilizer treatments were dusted at regular intervals with a copper dust, while the others were left undusted.

Significant differences in the amount of common leafspot were not found between the fertilizer plots which did not receive the copper dust. However, in the plots which received the copper dust there was significantly less leafspot in the plots where 5% magnesium was applied than in those plots where it was omitted; in so far as disease control is concerned, there seems to be a favorable reaction between the copper dust and magnesium. Significant differences in leafspot development were not found between plots which received 10% potash and those with no potash.

Highly significant differences in the amount of leafspot were found between the copper-dusted and the undusted plots, regardless of the fertilizer treatment.

Highest yields of both matured and No. 1 melons were obtained in the plots that were dusted with copper dust and that received a complete fertilizer, including 5% magnesium.

Flowering Dogwood Tells Time to Plant for Controlling Cabbage Maggot

In most of the cabbage growing regions of North Carolina above 3,000 feet in elevation, an early crop cannot be grown without danger of severe injury by root maggots. The grower must decide in advance whether to risk growing early plants without maggot control or whether the market for the earlier crop will be good enough to pay for the expense of maggot protec-

[1]Cooperation: Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture.

tion. The cost of the mercury insecticides has risen on account of the war. From studies made on the root maggot it is believed that a satisfactory program of growing cabbage without maggot protection can be used. The most important point is to delay planting until the flowering dogwood has come into bloom at the same altitude and exposure as the seed bed. The control of flea beetle in the seedbed and washing the roots of plants before setting, if more than 10% are infested by root maggots, will naturally increase the chances for a good crop.

Flowers

More Bulbs and Flowers with Less Fertilizer[1]

A bulb fertilizer experiment recently completed in the Castle Hayne section of Eastern North Carolina indicates that 1,000 pounds per acre of a 3-8-10 fertilizer gives a slightly higher yield of narcissus bulbs than 2,000 pounds of the same mixture. Among the minor elements, an application of 5 pounds of borax per acre produced a significant increase in yield of flowers on the King Alfred variety.

The experiment involved 37 different treatments, including the use of such minor elements as boron, manganese, magnesium, and copper and also studies on time, method, and rate of application. The 3-8-10 mixture was used as the basic formula since this is commonly used by bulb growers in the Castle Hayne section.

New Carnation for Southern Conditions

A promising red carnation developed in the State College greenhouses is attracting the attention of florists over the state because of its large flower size, long stems, and exceptional plant vigor. The new variety has been named Rebel and is being made available for trial by interested florists. The flowers are large, measuring 3½ to 4 inches in diameter, and have a full, high center. The color is a bright red. The petals are numerous, averaging 55 to 60 per flower during January, and are of good size. The flowers are produced very abundantly during the winter months when prices are highest.

The plant has a vigorous upright habit, with long, stiff stems, none of which have shown a tendency to be weak. Sufficient side shoots are produced for propagations, and the cuttings root quite readily. The foliage is clean and has been more or less resistant to the various leaf diseases.

Rebel was among the seedlings resulting from a cross made in 1935 between the pink variety My Love and Chief Kokomo, a variegated yellow. The new variety was developed in an effort to produce sorts better adapted to southern conditions. During the past six years the carnation breeding program has involved the trial of more than 1,100 seedlings resulting from 70 crosses. Variety trials begun in 1929 had emphasized the need of a breeding program if varieties suitable for the South were to be secured.

[1]Cooperation: Bureau of Plant Industry, U. S. Department of Agriculture.

LIVESTOCK AND POULTRY

Beef Cattle

Cottonseed Meal A Profitable Supplement to Grass Hay for Wintering Beef Cattle

Winter feed is the costliest item in beef cattle production in Western North Carolina where most beef producers can graze more cattle than they can winter. In an effort to winter as many cattle as possible with a minimum cash outlay for feed, many cattle are so severely undernourished during the winter that much of the following grazing period is required to regain the weight lost during the dry-feeding period. That this is poor economy is shown by experiments in which cottonseed meal increased gains of yearling cattle wintered on grass hay in 1939 on two Western North Carolina farms.

In one test, over a feeding period of 135 days, beginning December 5, 1939, using steers averaging around 530 pounds, the group fed grass hay with 2 pounds of cottonseed meal per head daily, gained 14.3 pounds per head, while the group on hay alone lost 65 pounds per head. The group receiving cottonseed meal gained an average of 58.2 pounds more for the entire year and showed a net profit of $3.42 per steer over those fed hay alone.

In a similar test on another farm, the steers weighed around 600 pounds and the wintering period extended over 148 days beginning December 4, 1939. In this test, the hay group maintained their fall weights, but the group fed cottonseed meal gained 57 pounds more per steer for the entire period from the start of the feeding period until taken off pasture the following fall, yielding a net profit of $2.49 more per steer.

Other tests in which corn was fed along with grass hay, with and without the addition of cottonseed meal, showed a decreasing need for the cottonseed meal with increasing amounts of corn. When as much as 2 pounds of crushed corn was fed daily, the addition of cottonseed meal was not profitable.

Native Reeds Valuable Grazing Crop

Studies at the Blackland Branch Station in Washington County indicate that large areas of native reeds in Eastern North Carolina can, under proper management, be converted into palatable and wholesome beef. Through the grazing of these reeds, feed that is now being wasted and representing a tremendous fire hazard to farm buildings and forests can be utilized for the production of beef cattle in an area where insufficient beef is produced to supply the local needs.

Beef cows and their suckling calves have made satisfactory gains from May 1 to November 15 when grazed exclusively on native reeds. In addition, the dry cows have gained approximately one-fourth pound daily from November 15 to January 15 when grazed on reeds that had not been used for summer pasture.

Can Cattle Be Fattened On Roughage Alone?[1]

Results to date indicate that a ration of roughage alone is not as economical and does not produce as palatable beef as one which contains both grain and hay.

The twenty grade cattle used in this experiment were fed principally on pasture and lespedeza hay until they were about 20 months old and weighed approximately 800 pounds each. They were then individually stall-fed until ready for slaughter, ten head being fed lespedeza hay alone, and the other ten head being fed shelled corn and lespedeza hay.

More rapid and economical gains were made by the cattle which had corn added to their ration. These cattle also produced beef that was more tender and palatable than those fed hay alone.

Dairy Cattle and Animal Nutrition

Feeds Rich in Vitamin A Valuable Supplements to Cottonseed Meal in Rations for Cattle

Vitamin A is recognized as an important constituent of livestock feed. This is especially true for dairy cows since Vitamin A, or its precurser (substance from which it can be formed), must be in the feed for the vitamin to be present in the milk.

An experiment was begun in 1930 at Raleigh to determine the amounts of soybean hay, locally grown alfalfa hay and local yellow dent corn that are necessary to supplement cottonseed meal and hulls, so as to provide sufficient Vitamin A for young growing beef cattle. When 20% of the ration consisted of soybean hay and 50% of cottonseed meal and hulls, enough Vitamin A was furnished for good growth. Soybean hay proved distinctly superior to locally grown alfalfa hay. The soybean hay was usually of No. 1 quality; the alfalfa hay graded No. 3 and contained grasses. Yellow dent corn did not prove to be as good a source of Vitamin A as alfalfa hay.

These experiments have shown that cows with calf, yearling steers and heifers can be fed large amounts of cottonseed meal and hulls when sufficient Vitamin A is supplied.

Vitamin Content of North Carolina Soybeans and Cowpeas

With the growing knowledge of the importance of vitamins in animal nutrition, information on the vitamin content of such important North Carolina feed crops as soybeans and cowpeas is of interest to livestock feeders. Assays have been made of the Vitamin A and Vitamin B contents on 15 samples of soybean seed including 9 varieties and 10 samples of cowpea seed including 8 varieties, all grown under North Carolina conditions. The so-called "rat growth" method was used in making these assays.

Contrary to results reported elsewhere, none of the samples of soybeans or cowpeas contained appreciable amounts of Vitamin A. On the other hand, all samples contained fair amounts of Vitamin B_1. The soybeans ranged from

[1]Cooperation: Bureau of Animal Industry, U. S. Department of Agriculture.

2.8 to 4.8 international units per grain and the cowpeas from 2.3 to 3.7 units. No marked difference among varieties was observed with either crop.

Supplementary Pastures and Silage Excellent Feed for Dairy Cows[1]

Experiments at the Lower Coastal Plain Branch Station point out that annual forage crops, such as small grains, soybeans, crimson clover, vetch and lespedeza, can be used to provide grazing, silage and hay for dairy cows. Fall-seeded small grain (rye, barley and vetch) furnished grazing from about March 1 to May 1. Crimson clover and Oregon vetch made satisfactory growth and were readily grazed by cattle.

Soybeans provided grazing from about the middle of June to the last of September with a carrying capacity of 75 cow days per acre. Pearl millet gave good grazing from the middle of July to the middle of September, with a carrying capacity of 89 cow days per acre.

Silages were made from corn and soybeans planted in the same drill and from soybeans alone. All soybean silage was put up without the use of preserving agents. The soybeans were allowed to remain on the ground, after being cut, until they wilted sufficiently to put on a rack as used in the usual hay making procedure. Corn and soybeans produced about 19,000 pounds of silage material per acre; soybeans alone produced about 15,000 pounds per acre.

Hay was produced in the spring from oats-vetch and oats-crimson clover and in the fall from soybeans. The oats-legume mixtures made about 2,500 pounds per acre; soybeans made about 3,000 pounds.

These studies suggest the possibility of developing economical methods of feed production in the Coastal Plain for livestock farmers.

Hogs

Mature Soybeans Satisfactory for Pigs During Early Fattening Period[2]

Each year large quantities of soybeans are left in the fields on North Carolina farms. Some of these are shattered beans that remain on the ground after harvesting while others are from beans that have been seeded as a soil improving crop. Since the pig is the only animal that can satisfactorily salvage these beans after they have fallen to the ground, an experiment was begun in 1937 to ascertain how useful these wasted soybeans might be for fattening pigs.

Previous experiments at this Station had shown that soft pork would result if peanuts were included in the ration of a pig that weighed more than 100 pounds. Since soybeans also produce soft pork, the present experiment was planned so as to start the pigs at initial weights of approximately 40 pounds, feed them on soybeans for a gain of 45 pounds, then change them to a corn ration containing 13% cottonseed meal for the latter part of the finishing period, or from an average weight of 85 pounds until they attained an average slaughter weight of 225 pounds.

[1]Cooperation: Bureau of Dairy Industry, U. S. Department of Agriculture.
[2]Cooperation: Bureau of Animal Industry, U. S. Department of Agriculture.

Mature Tokio soybeans "hogged down" are being compared with similar soybeans hand-fed in a dry lot. From results to date, it appears that a basic ration of soybeans, either in the field or dry lot, will produce as good gains and be utilized as satisfactorily when supplemented with a mineral mixture as when supplemented with a protein-mineral-alfalfa leaf meal mixture, except that a small amount of ground legume hay seems to be necessary when the pigs are confined to a dry lot.

Sheep

Small Grain-Lespedeza Valuable Supplementary Pasture for Sheep[1]

In sheep pasture experiments at the Piedmont Branch Station, begun in 1934, a rotation of Korean lespedeza and either Abruzzi rye or Italian rye grass produced greater rates of gain on ewes and their lambs than a permanent pasture composed chiefly of blue grass, orchard grass, red top, and white clover. There was very little difference in the length of the periods grazed or in the total grazing furnished per acre yearly. The chief advantage of the rotations was in providing grazing in the early spring when the ewes were lambing and before permanent pastures were available. Pasture rotations also aid in controlling internal parasites which are a serious menace to profitable sheep production in North Carolina.

In comparing the two rotations, it was found that rye and rye grass were apparently about equal as winter pastures, but the lespedeza that followed in the rotation was considerably better in the rye lots, which furnished grazing 21 days longer, had a carrying capacity of approximately 20% more, and produced 38% faster gains. Evidently the rye grass formed too dense a sod to be a good nurse crop for the lespedeza.

On the average, the rye was ready for grazing one week earlier in the fall than the rye grass but the latter provided grazing one week later in the spring. Early fall grazing is more important than late spring grazing; on most farms permanent pasture would be ready by the time the rye was completely grazed.

No difference in the grazing value of lespedeza seeded in rye as compared to lespedeza seeded in barley was noted in a one-year trial completed on October 17, 1940, in which barley was substituted for rye grass in the rotation.

A rotation of either rye-lespedeza or barley-lespedeza is practical when used in conjunction with permanent pasture in extending the grazing period. The amount of harvested feeds required will be greatly reduced and the flock will remain in a more thrifty condition than when permanent pastures are relied on entirely.

Soybean Hay—A Valuable Feed for Sheep

Most sheepmen realize the necessity of feeding legume hay, especially to bred and nursing ewes, if best results are to be obtained. Soybean hay,

[1]Cooperation: Bureau of Animal Industry, U. S. Department of Agriculture.

because of the comparative ease with which it can be grown in most sections of North Carolina, has been recommended by the Experiment Station as a good practical legume hay to supply.

Early tests by this Station showed it to be equal in feeding value to alfalfa hay. However, there is a wide variation in the quality of soybean hay produced throughout the State due to the different stages of maturity at which the crop is cut. Some hay is composed entirely of leaves and vines while some contains a high percentage of mature beans.

Two trials have been completed comparing hay cut in the bloom stage, with and without a supplement of shelled soybeans, with hay cut after the beans were mature. The ewes received per head daily 4 pounds of either mature or immature hay in two groups and 3.25 pounds of immature hay plus .75 pound of whole soybeans in the other group.

All sheep were wintered satisfactorily and there was no evidence of any harmful effects resulting from feeding either whole soybeans or mature soybean hay. The ewes receiving soybeans gained faster before lambing than those in the other lots, but there was no significant difference in the rate of gain of the lambs in the different lots. The indications are that whole soybeans might well constitute a substantial part of the ration for pregnant and suckling ewes.

Shearing Benefits Lambs

Lambs shorn at the beginning of hot weather gained more weight per head daily and were in better condition the following fall than lambs that were unshorn, experiments at Raleigh, Wenona, and Statesville showed. Although approximately the same weights at the start, the shorn lambs were heavier the next fall and graded higher as fat lambs. Moreover, the yield of wool from the shorn lambs plus the yield of wool from the same animals as yearlings averaged approximately one-half pound more than the yield of wool from the animals first shorn as yearlings. These results indicate that it would be a good practice to shear lambs that are to be retained in the breeding flock. It is believed that the better condition of the shorn lambs may be attributed to their greater comfort as a result of a lower body temperature.

Flushed Ewes Breed Earlier

Ewes on pasture that were flushed with grain two weeks before and two weeks after the ram was turned in, conceived quicker and lambed slightly earlier than those receiving no grain supplement in experiments conducted during 1939-40 in Western North Carolina.

Flocks were divided on two different farms and flushed during the fall of 1939. The flushed group received ½ pound of grain per head daily in both cases; shelled oats were used in one experiment while a mixture of shelled oats, cottonseed meal, wheat bran and rye was fed in the other. Although a variation in the average daily gain was noted between the two flocks on the two different farms, probably due to differences in pasture, the average number of days from date ram was turned until lambing occurred, varied inversely with the daily gain of the four groups during the flushing period. The four groups ranged in daily gains from 0 to .39 pounds per head during

the flushing period. The two flushed groups lambed 2.7 days and 4.3 days quicker than their respective no grain groups. However, the group making the greatest daily gain of .39 pounds lambed 7 days earlier than the ewes making no gain—indicating that ewes should be gaining in weight at the beginning of breeding season for quick conception.

Flushing just previous to breeding season is practiced by many of the better sheep producers in different parts of the country. Many farmers feed some grain during this period while others merely turn flock on better pasture. At any rate, from 1939 results, ewes that are gaining in weight seem to conceive quicker and would tend to produce a more uniform lamb crop.

Internal Parasites in Sheep Controlled by Proper Treatments[1]

The mild climate and long growing season in North Carolina are favorable to sheep production, but these conditions also favor the multiplication of internal parasites, which, if not controlled, become a most serious menace to profitable sheep raising.

Recent tests conducted from early spring to late fall at the Blackland, Central and Piedmont Stations, showed that sheep and lambs treated with either a copper sulphate-nicotine sulphate mixture or phenothiazine made satisfactory gains and remained thrifty. Earlier tests with these same flocks had shown that untreated animals either died or became very unthrifty.

The sulphate mixture was given in a drench and the phenothiazine in capsules. The ewes were treated four times during the year, the drnched lambs at two-week intervals, and the lambs receiving the capsules at four-week intervals. There was no significant difference in the gains or thriftiness of the groups receiving the different treatments. In the case of the lambs, the advantage of the less frequent treatments with phenothiazine was more than offset by its extra cost. This drug has been on the market for only a short time but may become one of our most important anthelmintics because it not only expells the parasites from the digestive tract, but also destroys the eggs.

Turkeys and Poultry

Superior Families of Turkeys Developed At Turkey Experiment Farm

Six single mated pens of large Bronze turkeys have been established at State College Turkey Experiment Farm in order to study whether or not such valuable factors as body type, egg production, hatchability of fertile eggs and livability of progeny are transmitted from generation to generation and, if so, to what extent. These pens include two pens of the Broad Breast type for which, apparently, a market demand exists.

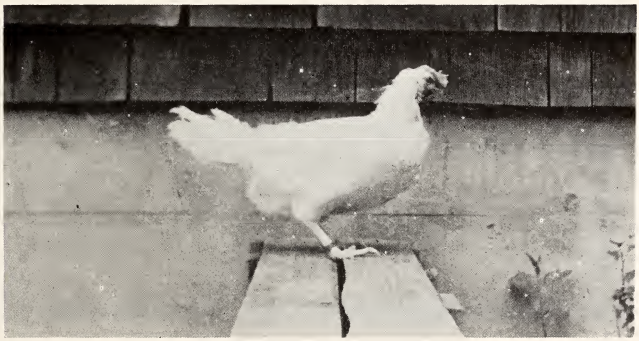
From these matings of last year approximately 100 toms have been dispensed to the turkey producers of the state as a source of new blood, which should aid in increasing numbers of eggs produced, hatchability of eggs and livability of progeny in crosses made. It is probable that the average egg production of turkey hens in North Carolina does not exceed fifty eggs a

[1]Cooperation: Bureau of Animal Industry, U. S. Department of Agriculture.

year, and crossings with toms from heavy producing dams should materially aid in production where such crosses are made. One pen of Broad Breasts at the Experiment Farm last year averaged over 100 eggs, with the high hen producing 167 eggs.

High Grade Peanut Meal Can Replace 50 Percent of Animal Protein In Laying Mashes

Two series of experiments at the Lower Coastal Plain Branch Station have shown that 62 to 94% of the animal protein in the laying mash can be replaced with a high grade peanut meal without any reduction in egg production, hatchability of eggs, or livability of chicks (livability being determined for ten weeks and on first series only).



BREEDING FOR LIVABILITY

Fig. 11.—This leghorn hen has laid over 1,000 eggs in five years. Such records are obtainable only by selection from families which show high livability.

As peanut meal is much less costly than animal protein concentrates commonly used in poultry mashes, substitutions as carried out in this project should result in materially reducing the cost of laying mash. Further studies are now in progress to determine whether or not similar substitutions may be made in starting and in growing mashes.

Do Crossbred Chicks Make Better Broilers and Layers?

A definite answer to the questionable superiority of crossbreds is being sought in an experiment conducted at the Mountain Branch Station at Swannanoa. During the early part of 1940 crosses were made between six different breeds with the matings arranged so that groups of crossbreds were compared with half-brother or half-sister purebreds. Most of the matings in 1940 were the different combinations possible between Barred Plymouth Rocks, New Hampshires, and White Leghorns. A few broilers came from

crossing White Rocks and Rhode Island Reds and Dark Cornish males with both New Hampshire and White Leghorn hens. Records are complete for the rearing of the broilers through ten weeks of age. Each broiler is weighed every two weeks, and records kept on hatchability, mortality, feather development, and in some cases feed consumption and market demand.

The results of the first year of work show very clearly that the value of crossbreds is greatly influenced by the parent stock. The New Hampshire hens crossed with Leghorn or Barred Rock males produced a broiler inferior in livability and growth to purebred New Hampshires, but Leghorn and Barred Rock hens mated with the New Hampshire cockerel produced a broiler superior in both respects to purebreds of all three breeds. There was a distinct value obtained in using the New Hampshire cockerel. In practically every case livability was higher for crossbreds than for purebreds.

White Leghorns May Be Bred for Resistance to Coccidiosis

Recent experiments have indicated that some White Leghorn chicks have an inherited resistance to coccidiosis, one of the most dreaded diseases of young chickens. It was observed in 1938 that in some families all or a large proportion of chicks died from the disease, but that in other families none died when a natural outbreak occurred in chicks hatched in the late spring. An experiment was begun in 1939 in which chicks were artificially infected with coccidia and then observed carefully. Every chick showed evidence of having contracted the disease.

Sixteen deaths occurred among 45 chicks from the susceptible stock, while only eight deaths occurred among 48 chicks from the resistant stock. In addition, chicks from the resistant stock had a lighter case of the disease than the other group. One family of 12 chicks among the resident group did not lose a single individual following the artificial infection.

Results obtained seem to indicate that a considerable amount of resistance to coccidiosis can be bred into fowls by using strains found to be highly resistant following artificial infection with the disease.

Mortality of Poultry Can Be Decreased Through Breeding

A decrease in general mortality in White Leghorns at the State College Poultry Farm, achieved through breeding, offers much hope to poultrymen who in recent years have been much concerned over the steady increases in mortality.

Several years ago a project was begun with the aim of developing strains of White Leghorns having a high average livability combined with satisfactory egg production. The first two years' work showed wide differences in mortality among families. In some instances as many as 19 full sisters went through a complete laying year without a single loss through death, while in other large families a third or more died before completing a year.

Pullets trapnested during 1939-40 came from matings designed to show the influence of selecting breeders from families having good and poor livability. Every dam used had completed at least one laying year and was either progeny-tested or sub-tested for livability. Breeders in two pens came from families having shown average livability, and their progeny showed

a survival percentage of 66 and 69. Breeders in four pens came from families having shown superior livability, and their progeny showed survival percentages of 66, 66, 79 and 84. Thus, in two cases selection did not increase livability above the average, but in two other cases there was a considerable increase.

It costs around one dollar to rear a pullet to the age at which laying begins. In North Carolina approximately one-fourth of all pullets either die or must be culled from flocks because of their physical condition before they have produced eggs for one year. This great replacement of stock is expensive and the reduction in mortality by a few percentage points will save thousands of dollars for our poultrymen. Results secured in this project indicate that one way to reduce mortality is through breeding.

Tapeworms Retard Growth of Chickens

Recent studies have shown that North Carolina chickens may be infested with at least five different species of tapeworms. Of this number, three species are found to be very prevalent. Over 48% of 423 chickens sent to the poultry disease laboratory from North Carolina farms were infested with tapeworms. Chickens become infested with tapeworms by eating beetles, flies, ants, etc., which contain "immature tapeworms." The most prevalent species in the state utilizes a small brown ant as its intermediate host. This fact was shown by a survey of thousands of ants from North Carolina poultry farms.

The discovery of beetles as intermediate hosts of chicken tapeworms has facilitated experimental studies on the effects of tapeworms among chickens. By feeding tapeworm segments to beetles, it was possible to obtain large numbers of "immature tapeworms," which were fed to chickens under controlled conditions. Preliminary experiments indicate that growing chickens, infested with tapeworms, do not grow so rapidly as tapeworm-free chickens. Other experiments demonstrate that infestation with tapeworms causes a definite inflammation of the chicken intestine.

SOILS AND FERTILIZERS

Soils

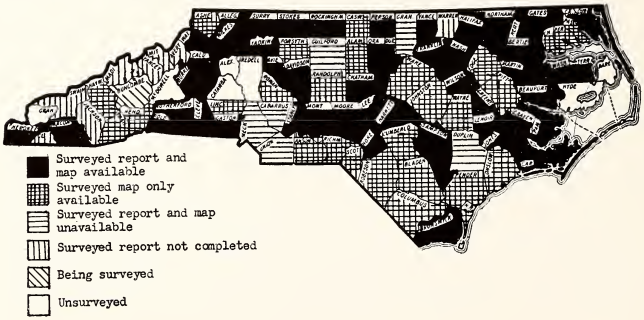
Survey Reports Show Soil Resources of the State

Soil surveys and reports of Jackson, Mitchell, Yancey, and Haywood counties have recently been completed; the survey of Cherokee County has been completed but the report is not available; one one-fourth of the field work in Buncombe County has been finished.

All the soil survey work in the state is conducted cooperatively with the Federal Bureau of Plant Industry and with the Tennessee Valley Authority. The various soils occurring in each county are identified, classified and mapped. In mapping, the degree of slope, erosion, and stoniness are

shown for each type of soil occurring. The extent, location, and crop adaptation of each soil type is given.

In these reports, soil types are carefully grouped, according to their special crop adaptations, into first, second, or third class agricultural soils; those not adapted for any reason to crop production are grouped for pasture or forest uses, respectively, as best suited. The completed soil map for each county with the report, gives a rather comprehensive inventory of the soil resources of the different counties surveyed. Other information included in the reports are location of the county, its history, size, boundaries, topography, streams, towns, drainage, transportation, and communication facilities, density of population, markets, climate and general agriculture; average acreage yields, cash value of crops and the amount and analyses of fertilizers used per cre on each crop are reported.



The published report for each county supplies a fund of definite agricultural and soil information of considerable value to practical farmers and to the trained scientific agricultural workers engaged in the solution of many economic crop and soil production problems of the county and region. Many industries, too, find the county soil maps and reports in many cases of considerable aid to them in the solution of many of their problems. Highway engineers and rural teachers are finding the reports to contain much information which they can use to great advantage in their respective lines of work.

Soil Management Surveys Show Interesting Facts

A recent survey in one of the Piedmont counties of the state has shown that more than two-thirds of the total cultivated land was in row crops (mainly corn, cotton, and tobacco) and less than one acre out of eight was in legumes. About 70% of the legumes were harvested, leaving only 30%, or about one acre out of every 25, which had a legume turned under for soil improvement. Those that were turned were too poor to harvest.

One acre out of three of corn and one out of ten of cotton were not fertilized at planting time. That which was fertilized received only about

one-third to one-half the amount recommended by the Experiment Station. Moreover, the analysis was low, averaging about a 3-8-3 on corn and cotton and about 3-8-4 on tobacco.

More than 80% of the total land area had lost much of the fertile topsoil and very little was being done to control erosion. Much of the land was not terraced; only one acre out of 30 was strip-cropped; no definite rotations were followed; and the rows were run up and down the hill on three acres out of every five. These practices were all reflected in low yields; corn averaged only 18 bushels per acre and cotton only 260 pounds.

A similar survey in a Coastal Plain county showed that about four out of five cultivated acres were in row crops. This is higher than in the Piedmont county but erosion is not as serious as in the Piedmont. Depletion of soil fertility, however, is serious and the nutrients removed by crops and leaching must be replaced by commercial fertilizers or farm manures.

The results of the survey show that considerably less fertilizer is used than has been found best by experiment. On corn, less than one-third as much was used as is recommended; on cotton, less than one-half, and on tobacco, about 90%. All cotton and tobacco are fertilized but only 70% of the corn is fertilized at planting time. Only one acre out of 175 is limed annually (average). As in the Piedmont county, this is reflected in the low acreage of legumes. Approximately one acre in ten was in legumes. About two-thirds of these are double-cropped and three-fifths of them are removed for hay. Thus, instead of being used for soil improvement, the legumes are simply removing more nutrients from the soil. Only one acre in 24 had a legume plowed under for soil improvement.

Organic Matter Helps to Granulate Soils and Reduce Erosion[1]

Laboratory studies from the soil erosion plots on the old Erosion Experiment Station near Statesville have shown a close relationship between soil granulation and erosion. Organic matter was found to be of extreme importance for promoting granulation.

Land that was in culture for several years had a poorer physical condition than land which had grass or legumes turned under. The difference is due to several factors. First, the cotton land was cultivated more, thus destroying granules; second, the grass or legumes formed humus which cemented the clay particles together; and third, more microorganisms, such as fungi and bacteria, grew where the grass and legumes were turned under and they caused granulation. The effects of the legumes lasted only a year or two, suggesting that it is necessary to add them at regular intervals, say once in a three or four-year rotation to maintain the organic matter supply. Less erosion occurred, for example, under cotton which followed a green manure crop than under cotton which followed cotton.

Drainage and Aeration of Soils Determined by the Size of the Soil Pores[1]

Runoff and soil losses on the erosion plots at the old Erosion Experiment Station near Statesville have suggested that the amount of runoff is related to the internal drainage or permeability of the soil profile. Observation of

[1]Cooperation: Soil Conservation Service, U. S. Department of Agriculture.

runoff losses on other Piedmont soils indicate that the various soils differ considerably with respect to porosity. Not only does poor internal drainage or permeability make the soil impervious to water but it also results in a low supply of air to plant roots, and, therefore, in poor plant growth.

Laboratory methods have been devised to measure internal drainage by determining the amount and size of the pore spaces in the soil. It has been found that the size of the pores is more important than the total amount of pore volume. This is true of the Iredell, Cecil, and Davidson, three important Piedmont soils. Of the three, the Davidson has the highest clay content in the subsoil and the Iredell has the lowest, yet due to differences in the nature of clay, the Davidson has a high percentage of large pores and the Iredell has none. The Cecil is intermediate. This difference in physical properties makes the Davidson adapted to a greater number of crops and more productive than the Iredell.

Crop Production Related to Soil Aeration

Investigations at the Soil Research Laboratory near Wilmington indicate that one of the most serious problems in eastern North Carolina, even on the light sandy soils, is poor aeration or a low state of oxidation. This may be caused by temporary waterlogging and the failure of the soil to maintain its stability under such conditions long enough to prevent a setback to crop growth. It is often thought that this is a consequence of the loss of plant nutrients by leaching, but the best evidence available indicates that it is caused by damage to plant roots and that leaching is not a major problem on most of these soils.

The degree of aeration of soils can, under ideal conditions, be measured by electrical means, but in practice the results are too erratic to be useful. This is especially true in the less acid soils with which much of the experimental work has to be done.

It has been possible to show, however, that the adverse effect on the soil of the exclusion of air is aggravated by the application of phosphatic fertilizer, but reduced by the addition of iron oxide.

This evidence, which has been confirmed by two methods, gives a satisfactory explanation for the apparent inefficiency of superphosphate on sandy soils and in part for the natural productiveness of soils which contain enough iron to give them a red or yellow color. In practice, it has been shown that the efficiency of superphosphate can be greatly improved by the addition of copper to fertilizers.

While it is evident that the leaching of plant nutrients has been greatly overemphasized, results have been obtained showing that the elements calcium, magnesium, and potassium are brought into solution as the degree of aeration of the soil is lowered following the exclusion of air.

From this evidence it would appear that plant nutrients may be lost more readily from poorly drained than from well drained soils, even where the amounts of water draining through the soil are identical.

In the course of this work it has been shown that the presence of moderate amounts of iron oxide in the soil will prevent the development of extreme soil acidity as well as stabilize the condition of oxidation.

Soils very low in iron content and high in organic matter, on the other hand, may become very acid, the limit being fixed by the acidity which prevents the formation of nitric acid from the organic matter by soil bacteria at a minimum of about pH 3.6.

In mineral soils this minimum limit is at a much lesser degree of acidity at pH 5.0 or slightly higher.

Fertilizers

North Carolina Soils Low in Available Boron

Analyses of 160 samples of soil from the two major types in each county of the state have shown that most North Carolina soils have a very low available boron content, both in the surface and subsoil. Surface soils contained from ⅓ of a pound to slightly less than one pound of boron per acre; subsoils ranged from 1/5 of a pound to ¾ of a pound per acre.

Greenhouse studies have shown that liming some soils either tends to fix available soil boron or to increase the boron requirements of plants, since definite boron deficiencies were produced. Other greenhouse studies on a heavily limed Cecil clay loam soil from Statesville with a pH of 7.4 showed that the addition of about 2 pounds of boron per acre eliminated boron deficiency symptoms on cotton seedlings.

The addition of boron to alfalfa, showing boron deficiency symptoms as evidenced by short, yellow plants, has resulted in the elimination of this deficiency symptoms with a corresponding increase in growth. Chemical analyses of the plants show a greater intake of boron where the deficiency has been corrected by the use of additional boron to the soil.

These results suggest that the cause of abandonment of the growth of crops such as alfalfa and red clover, and others, by many farmers may be due to the fact that boron does not exist in some soils in sufficient amounts to support proper plant growth.

Field Experiments Show Comparative Value of Different Phosphate Fertilizers

Superphosphate has consistently produced higher yields than rock phosphate at both the Blackland and Piedmont Branch Stations when added in amounts to give equal quantities of phosphoric acid. Increasing the amount of phosphoric acid, applied as rock phosphate, above the normal amount did not increase the yields sufficiently to justify the larger application.

Experiments throughout the state with various other sources of phosphate including high analysis phosphatic materials, that are being produced on an experimental basis by the Tennessee Valley Authority, have shown that these newer forms of phosphate compare very favorably with superphosphates. Certain of the newer phosphates appear rather promising as carriers of phosphoric acid, especially from the point of view of decreased costs of handling and applying to the land.

Higher Yields Result from Correct Placement of Fertilizers[1]

Cotton fertilizers produce the most cotton when placed at planting time in bands 2½ inches to each side of the seed at a level 2 inches below that of the seed. This placement was found to give the best assurance of good seed germination, a minimum of seedling injury and maximum yield. Mixing the fertilizer with the soil under the seed was superior to placing the fertilizer in a band under the seed.

The average return from side placement during nine years of field experimentation was $7.34 (cotton valued at 3½ cents per pound) per acre in comparison to a band placed under the seed and $5.14 per year in comparison to mixing the fertilizer with the soil under the seed.

The same money spent for fertilizer gave a gross return of $15.25 when applied in a band under the seed, $17.47 when mixed with the soil under the seed, and $22.61 when applied as a side placement.

Results from placement experiments with corn have shown that fertilizer placed in contact with the seed or one inch under the seed delays germination and early growth. Placing the fertilizer in a band 3 inches under the seed or mixing the fertilizer with the soils gave results fairly comparable with side placement.

Neutral Fertilizers Increase Yields of Sweet Potatoes, Irish Potatoes and Cotton

Plots of Irish potatoes, sweet potatoes, and cotton that have received neutral fertilizers have consistently outyielded those receiving acid fertilizers. With sweet potatoes, the returns from neutralizing the fertilizers increased as the potash was increased in the mixture. These increases were 3.7 bushels for 3% potash, 11.1 bushels for 6%, and 14.2 bushels for 9%.

Neutralizing fertilizers with dolomitic limestone has increased the average yields of Irish potatoes as much as 32 bushels. Basic fertilizers have shown increases up to 46 bushels. The results of three successive years with acid, neutral and basic fertilizers applied on the same plots have not indicated an increase in potato scab infestation resulting from the neutral or basic fertilizers. These soils had an initial reaction of pH 4.5 to 5.0. Soil tests showed that the pH value was increased by about 0.3 to 0.4 pH in the zone where the fertilizer was applied. The importance of maintaining a reaction below pH 5.5 to avoid scab has retarded the general use of neutral fertilizers for Irish potatoes. However, increased yields and the availability of magnesium in the dolomitic limestone used as a neutralizing agent justifies the use of neutral fertilizers on soils which are much below pH 5.5 and on which scab already is not known to exist.

Cotton yields have been increased more than one-half bale per acre by

[1]Cooperation: Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture.

the use of neutral fertilizers. The effect of neutral fertilizers on the yield of cotton and potatoes is shown in the following table:

Crop	Soil Type	Yields per acre		Increased yields per acre due to neutral fertilizer
		Acid	Neutral	
Irish potatoes	Bladen fine sandy loam	222 bu.	255 bu.	32 bu.
	Portsmouth sandy loam	198 bu.	213 bu.	15 bu.
Sweet potatoes	Norfolk loamy fine sand			
	light phase	141 bu.	156 bu.	15 bu.
	heavy phase	139 bu.	148 bu.	9 bu.
Cotton	Norfolk sandy loam	896 lb.	1162 lb.	266 lb.

ECONOMIC PROBLEMS

Farm Owners Benefit by Tax Relief Program

A reduction in the tax burden on farm real estate, stabilization of tax rates, and a decrease in tax delinquency have all resulted from the legislative taxation program of recent years, according to a detailed study of 800 farms in 52 counties made by agricultural economists. Principal contributing factors have been the assumption by the state in 1931 of the six months' constitutional school term hitherto supported by local taxation, the additional one-cent gasoline tax levied since 1931 and distributed to counties, and the 3% sales tax in force since 1933.

Prior to these changes, a critical need for reduction in farm real estate taxes had arisen from a sky-rocketing advance in rates from 1913 to 1928. From an average tax of 10 cents per acre in 1913, one of the lowest rates in the country, rates increased 540%, or to 64 cents per acre in 1928. Since the legislative program went into effect, the tax rate per acre on farm property has declined one-half, or to 32 cents. A notable tendency for the stabilization of tax rates has also accompanied this program. This is shown by the fact that the average tax rates per acre on farm real estate varied less than 5 cents during the period 1935 to 1940.

Another fact brought out by the survey is that tax delinquency which attained considerable proportions during the depression has been greatly reduced. Data for 610 tax delinquent farms distributed in 13 counties showed $34,608 of taxes delinquent in February, 1932. Of this all but $5,060, or 14.6%, had been liquidated by February, 1937. Moreover, other data for these same farms show that in addition to liquidating these delinquent taxes enough farms had been able to pay their current taxes promptly to reduce materially the total volume of delinquent taxes by February, 1938. The declining tax rate on farm property and increased farm income probably both contributed to this result.

Farmers in Eroded Areas Poorly Housed

Depletion of soil fertility and poor housing go together, according to a study of the social and economic effects of soil erosion. In one badly eroded area, 114 families were studied with respect to housing, household equipment, grounds, etc. Although the majority of houses were weather tight there was considerable variation among the tenure groups. A much smaller proportion of Negroes lived in weather tight houses than did the white families. Also, only a very few of the families lived in houses which had paint in good condition. However, about one-half of the houses occupied by owners had been painted but the paint was old and cracked, giving little or no protection. About one in three of the tenant houses, one in six of the cropper houses, and one out of each ten farm laborer houses had been painted but the paint was protecting the exterior walls very little. About one-third of the roofs on houses occupied by owners were classified as good. For the other tenure groups the proportions with roofs in good condition were: tenants, one-fifth; croppers, one-sixth; and laborers about one-fifth. Here, again, the proportion of houses with roofs in good condition occupied by Negroes was much smaller than that for the white families.

Net Farm Incomes Increased by Soil Conservation Practices[1]

Net farm incomes will be increased on farms following a soil conservation program after this program has become fully effective, according to studies

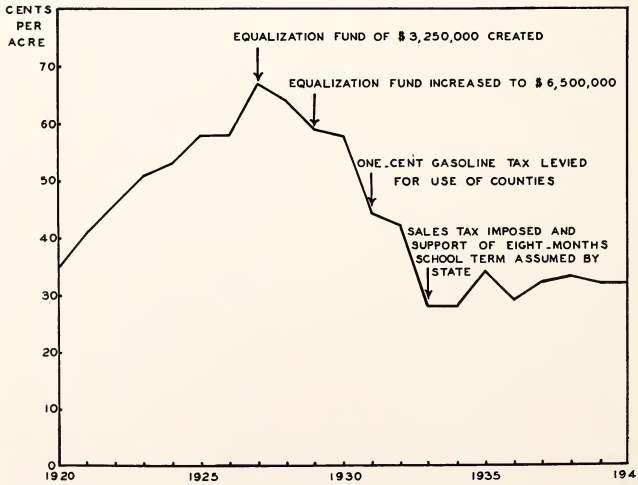


Fig. 12.—Relation of State Tax Legislation to Decline in Tax Rates Per Acre on Farm Land.

[1]Cooperation: Soil Conservation Service and the Bureau of Agricultural Economics, U. S. Department of Agriculture.

of representative farms in Franklin County. Among the important factors contributing to the increased incomes are: the use of idle land for productive purposes, the increased productivity of the land resulting from the use of soil conserving and soil improving crops and from the protection of the soil from erosion by adequate terraces, terrace outlets, strip cropping and contour tillage. Also contributing to higher incomes is the increase in livestock production on some of the larger farms. Some reduction in net farm incomes is likely to occur during the period when the change from the old system of farming to the soil conserving system is being made. This decrease results because of the extra expenses for such items as seed and fertilizer connected with the operation of the soil conserving system which are not met by increased incomes until farm productivity has been increased. However, a study of representative farms indicates that the temporary reduction in income is not likely to be as serious on large farms as on the small one-mule farms.

Bad Leasing Arrangements Among Causes of Poor Land Utilization[1]

Defective landlord-tenant relations is one of the major causes of poor land use. That this is the case is evident from the results of a survey of 43 farms located in Caswell County. One of the causes, according to this survey, of poor landlord-tenant relationships is the fact that many of the landlords do not live on the farm nor in the immediate neighborhood where the farm is located. This makes frequent contact with the tenant difficult or impossible, and it is well known that frequent contact between the tenant and landlord is necessary if the farm is to be organized and operated efficiently.

Another cause of poor landlord-tenant relationships is the general absence of definite rental arrangements. In a large majority of cases the arrangements are oral rather than written, which gives ample opportunity for misunderstanding between the tenant and the landlord. The present rental arrangements do not include any definite provision with respect to the details of organization and operation of the farm. On the contrary, they simply stipulate in general the types of crops which shall be grown and the division of the receipts that will be made; but with respect to minor details, the arrangements are particularly defective. Nor do the rental arrangements provide for the production of crops and livestock products for home and farm use. This defect is of major significance, especially in the low-income areas such as Caswell County.

Returns of Low-Income Farmers Can Be Raised[1]

What can be done to improve the income of "low-income farmers?" To answer this question, a study was made of 26 representative farms in five general areas in Caswell County. The results show that in most cases the income of the low-income farms can be materially increased by a more adequate utilization of the land and labor resources, by the production of more feed, by the keeping of more livestock to produce livestock products for farm consumption, and by the establishment on each farm of a soil conservation program. In some cases, such will require resources for the

[1]Cooperation: Bureau of Agricultural Economics, U. S. Department of Agriculture.

purchase of seed, fertilizer, equipment, and buildings not now possessed by farmers, but in most cases the additional capital required is not great. What is chiefly required is a definite plan for each farm and some supervision during the initial stages of the development. If these requirements can be met, low-income farmers can maintain their incomes at a satisfactory level.

Farmers' Mutual Insurance Companies Show Growth in North Carolina

How important are Farmers' Mutual Insurance Companies in North Carolina? How large have they grown? What do they offer farmers? In a survey of all farmers' mutual insurance companies, it was found that the amount of insurance in force by all companies has grown from 26 million in 1933 to 44.3 million in 1938. These companies suffered, as did others, in the years of the depression; but they are building rapidly toward the high year of 1931, when they had 54.6 millions of insurance on their books. The amount of reserves has likewise grown from a low point in 1932 to a new high in 1938. The companies as a group had 10.7 cents in reserves per $100 of insurance in force in the low year of 1932 and 99.6 cents in 1938. All companies suffered losses during the depression years. As a group their losses were 52.2 cents per $100 of insurance in force. Losses, however, have declined until in 1938 it was only 17.2 cents per $100 of insurance. Because of the low overhead and the carefully selected risks, cost of insurance to farmers is low. In 1938 the assessments on members averaged 35.5 cents per $100 of insurance. The company showing the lowest rate was able in 1938 to furnish insurance to farmers at the phenomenal rate of 15 cents per hundred. These figures indicate a high degree of success for this type of farmers' cooperative activity.

The Past Decade Sees Important Changes in Coastal Plain Farming

What effect did the agricultural depression have on the organization and the incomes of farms operated by croppers? This question is discussed in a study of 112 farms located in the Coastal Plain Area of North Carolina over the period from 1928 to 1937. The significant change in the crop roduction was a decrease in the acreage devoted to cotton, tobacco, and peanuts. partially as a result of the decrease in row-crop production, there was a small increase in small grain production, soil improving crops, and pasturage. Despite the fact that the production of livestock is not an important activity on these farms, more attention is now being given to livestock than was the case in 1928. For example, during the period covered by this study there was a marked increase in dairy cows per farm, a large increase in the amount of pork produced, and considerable increase in the production of poultry and eggs. Sheep production, however, declined throughout the period, whereas work stock remained about constant.

The gross income fluctuated greatly. In 1928 the average gross income per farm was $11,041; in 1930 it was approximately one-half this amount, or $5,318; it then rose to $9,177 (exclusive of government payments) in 1934, and declined again in 1937 to $8,798. The movement in net farm income was about the same as for the gross income per farm. In 1928 the average net income was $2,758. This declined to $284 in 1930 in 1930 but rose to $3,050 in 1934 and then declined to $2,595 in 1937.

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AGRONOMY INFORMATION CIRCULARS

No.

114—*Preliminary Tests of Corn Hybrids in North Carolina,* by G. K. Middleton and P. H. Harvey (December, 1938).

115—*Spacing Virginia Type Peanuts,* by R. L. Lovvorn and P. H. Kime (January, 1939).

116—*Approved Fertilizers for Different Crops Grown in North Carolina* (January, 1939).

117—*Progress Report on Fertility Investigations with Peanuts in 1938,* by E. R. Collins and H. D. Morris (March, 1939).

118—*Timely Fertilizer Facts for North Carolina Farmers,* by C. B. Williams (April, 1939).

119—*Tobacco Fertilizer Recommendations for 1940* (August, 1939).

120—*Use of T. V. A. Phosphates on Pastures*—A Progress Report 1938-1939 Based Upon Field Experiments, by W. W. Woodhouse, Jr. (January, 1940).

121—*Some Practical Findings from Fertilizer Experiments in North Carolina with Different Crops,* by C. B. Williams (January, 1940).

122—*Approved Methods of Applying Fertilizers to Crops Grown in the Coastal Plain Section of North Carolina,* by E. R. Collins and H. D. Morris (January, 1940).

123—*Soil Fertility Investigations with Peanuts,* by E. R. Collins and H. D. Morris (January, 1940).

124—*The Performance of Corn Hybrids in North Carolina,* by P. H. Harvey and G. K. Middleton (February, 1940).

125—*Peanut Breeding and Variety Studies* (A Progress report), by G. K. Middleton, Paul H. Harvey, Harold F. Robinson and Julian W. Farrior.

126—*I. Factors in Soybean Production; II. Variety Recommendations and Characteristics,* by R. L. Lovvorn (August, 1940).

127—Flue-cured Tobacco Fertilizer Recommendations for 1941 (August, 1940).

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of the

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December 1, 1940

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LONNIE GRIFFIN ..... *Herdsman, Animal Husbandry*
L. Y. PARKER ..... *Foreman*
J. S. SHEARS ..... *Herdsman, Dairy*

DAIRY RESEARCH FARM, STATESVILLE

B. F. Mills ..... *Foreman*

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HOLLAND ALLEN ..... *Foreman*
BRYAN HARRIS ..... *Herdsman*

Lower Coastal Plain Branch Station, Willard, N. C.

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C. O. BOLLINGER ..... *Poultryman*
G. H. MECKSTROTH, Ph.D. ..... *Associate Pathologist, Bureau of Plant Industry, U.S.D.A.*
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Tobacco Branch Station, Oxford, N. C.

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K. J. SHAW, M.S. ..... *Assistant Tobacco Invest., Bureau of Plant Industry, U.S.D.A.*
T. E. SMITH, Ph.D. ..... *Assistant Tobacco Invest., Bureau of Plant Industry, U.S.D.A.*

Upper Coastal Plain Branch Station, Rocky Mount, N. C.

R. E. CURRIN, JR. ..... *Assistant Director In Charge*
WM. ALLSBROOK ..... *Foreman*
J. P. YOUNG ..... *Assistant Tobacco Investigations, Bureau of Plant Industry, U.S.D.A.*

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* The six branch station farms are owned and operated by the North Carolina Department of Agriculture, and the employees on these farms are members of the Department of Agriculture staff.

[1]In cooperation with Bureau of Plant Industry, U.S.D.A.
[2]In cooperation with Bureau of Animal Industry, U.S.D.A.
[3]In cooperation with Bureau of Dairy Industry, U.S.D.A.
[4]In cooperation with Bureau of Agricultural Economics, U.S.D.A.
[5]In cooperation with Bureau of Agricultural Chemistry and Engineering, U.S.D.A.
[6]In cooperation with Soil Conservation Service, U.S.D.A.
[7]In cooperation with Agricultural Marketing Service, U.S.D.A.
[8]In cooperation with Tennessee Valley Authority.

FINANCIAL STATEMENT

The following is a certified statement of the receipts from the Treasurer of the United States, supplementary funds from the State Department of Agriculture, and sales from the Station farms, with a record of their disbursements:

	FEDERAL FUNDS				Bankhead-Jones Offset
	Hatch Fund	Adams Fund	Purnell Fund	Bankhead-Jones Fund	
Dr.					
To receipts of the Treasury of the United States, as per appropriations for fiscal year ended June 30, 1940	$15,000.00	$15,000.00	$60,000.00	$102,628.00	None
Cr.					
Personal services	$ 9,472.87	$12,591.00	$45,732.76	$78,021.99	$53,761.05
Supplies and materials	468.32	771.66	4,857.21	7,060.11	10,092.97
Communication service	162.94	21.54	276.53	176.20	679.16
Travel expense	292.50	584.42	3,816.33	5,921.26	9,387.30
Transportation of things	.10	1.80	26.75	169.61	121.81
Printing and illustrating publications	356.98	...	450.01	19.43	17.50
Heat, light, water, power	40.89	4.60	316.98	341.68	1,269.36
Contingent expenses	....	...	1.32	2.20	13.53
Equipment	3,469.92	1,008.26	4,522.11	9,853.46	10,472.81
Land	.....	.....	.....	799.15	9,443.18
Structures and non-structural improvements	735.48	16.72	.....	262.91	11,228.62
Total	$15,000.00	$15,000.00	$60,000.00	$102,628.00	$106,487.29

Interest earned on above, during the period indicated, aggregating —NOTHING—, was covered by check No. —NONE—, drawn by —xxx—, to the order of the Department of Agriculture to be deposited in the United States Treasury.

We, the undersigned, duly appointed auditors of the expenditures from Federal appropriations and Bankhead-Jones offset funds reported herein, do hereby certify that we have examined the books and accounts of the North Carolina Station for the fiscal year ended June 30, 1940, that we have found the same well kept and classified as required, and that the balances, receipts, and disbursements are as follows:

	FEDERAL FUNDS					Bankhead-Jones Offset
	Hatch	Adams	Purnell	Bankhead-Jones	Total Federal Funds	
Balance from preceding year	None	None	None	None	None	
Receipts from the Treasurer of the United States	$15,000.00	$15,000.00	$60,000.00	$102,628.00	$192,628.00	
Receipts from sources within the State	.....	.....	.....	.....	.....	.....
Total	$15,000.00	$15,000.00	$60,000.00	$102,628.00	$192,628.00	$106,487.29
Disbursements	15,000.00	15,000.00	60,000.00	102,628.00	192,628.00	$106,487.29
Balance June 30, 1940	None	None	None	None	None	

Proper vouchers for the above disbursements are on file and have been examined by us and found correct.

We further certify that the expenditures have been solely for the purpose set forth in the Acts of Congress approved March 2, 1887, March 16, 1906, February 24, 1925, and June 29, 1935, and in accordance with the terms of said acts, respectively.

(Signed) I. O. SCHAUB,
Acting Director of the Experiment Station.
A. F. BOWEN, Treasurer
Financial Officer of the Institution.
ALEX ANDREWS,
Secretary of the Governing Board.

ATTEST:
H. H. HUTCHINSON,
Custodian of the Seal.

The North Carolina Agricultural Experiment Station

In Account With

Farm and Miscellaneous Receipts.

Dr.

	Balance from Previous Year	Receipts for 1940	Total
General Fund	.....	$ 61,000.00*	$ 61,000.00
State Department of Agriculture	.....	26,350.00	26,350.00
Special endowments, industrial fellowships and similar grants	$6,246.71	3,871.27	10,117.98
Sales	1,377.51	14,864.75	16,242.26
Total	$7,624.22	$106,086.02	$113,710.24
Less Non-Offset			7,222.95
			$106,487.29

* $65,000 was appropriated by the Legislature from the General Fund but only $61,000 was made available by the Budget Bureau.

Cr.

Salaries	$ 43,788.00
Labor	10,504.54
Stationery and office supplies	438.90
Scientific supplies, consumable	1,216.77
Feeding stuffs	5,007.34
Fertilizers	1,030.77
Sundry supplies	2,689.52
Communication service	1,054.11
Travel expense	9,414.64
Transportation of things	187.17
Publications	21.00
Heat, light, water, power	1,280.88
Contingent expenses	521.72
Furniture, furnishings and fixtures	1,854.37
Library	145.55
Scientific equipment	1,877.49
Livestock	2,573.99
Tools, machinery and appliances	4,093.35
Land	9,443.18
Buildings	11,228.62
Unexpended balance	5,338.33
Total	$113,710.24
Less Non-Offset	7,222.95
	$106,487.29

FINANCIAL STATEMENT

The following is a certified statement of the receipts from the Treasurer of the United States, supplementary funds from the State Department of Agriculture, and sales from the Station farms, with a record of their disbursements:

	FEDERAL FUNDS				Bankhead-Jones Offset
	Hatch Fund	Adams Fund	Purnell Fund	Bankhead-Jones Fund	
Dr.					
To receipts of the Treasury of the United States, as per appropriations for fiscal year ended June 30, 1939	$15,000.00	$15,000.00	$60,000.00	$89,799.50	$99,790.88
Cr.					
Personal services	$10,892.41	$12,629.61	$48,825.81	$70,955.21	$71,461.83
Supplies and materials	653.25	804.43	4,214.20	5,261.08	14,335.13
Communication service	187.14	35.15	152.75	47.69	219.51
Travel expense	1,023.83	637.90	2,237.02	7,097.09	4,023.42
Transportation of things	38.62	35.95	68.40	434.22	83.58
Printing and illustrating publications	501.52	....	1,051.66	44.10	306.15
Heat, light, water, power	.....	9.34	302.44	327.60	642.40
Contingent expenses	.....	.....	1.02	12.95	22.93
Equipment	1,703.23	822.03	2,929.59	4,108.92	7,564.17
Buildings and land	.....	25.59	217.11	1,510.64	1,131.76
Total	$15,000.00	$15,000.00	$60,000.00	$89,799.50	$99,790.88

Interest earned on above, during the period indicated, aggregating —NOTHING—, was covered by check No. —NONE—, drawn by —xxx—, to the order of the Department of Agriculture to be deposited in the United States Treasury.

We, the undersigned, duly appointed auditors of the expenditures from Federal appropriations and Bankhead-Jones offset funds reported herein, do hereby certify that we have examined the books and accounts of the North Carolina Station for the fiscal year ended June 30, 1939, that we have found the same well kept and classified as required, and that the balances, receipts, and disbursements are as follows:

	FEDERAL FUNDS					Bankhead-Jones Offset
	Hatch	Adams	Purnell	Bankhead-Jones	Total Federal Funds	
Balance from preceding year	None	None	None	None	None	
Receipts from the Treasurer of the United States	$15,000.00	$15,000.00	$60,000.00	$89,799.50	$179,799.50	
Receipts from sources within the State	.....	.....	.....	.....	.....	$99,790.88
Total	$15,000.00	$15,000.00	$60,000.00	$89,799.50	$179,799.50	$99,790.88
Disbursements	15,000.00	15,000.00	60,000.00	89,799.50	179,799.50	99,790.88
Balance June 30, 1939	None	None	None	None	None	

Proper vouchers for the above disbursements are on file and have been examined by us and found correct.

We further certify that the expenditures have been solely for the purpose set forth in the Acts of Congress approved March 2, 1887, March 16, 1906, February 24, 1925, and June 29, 1935, and in accordance with the terms of said acts, respectively.

(Signed) I. O. SCHAUB,
Acting Director of the Experiment Station.

A. F. BOWEN, Treasurer
Financial Officer of the Institution.

ATTEST:

H. H. HUTCHINSON,
Custodian of the Seal.

H. M. LONDON,
Secretary of the Governing Board.

The North Carolina Agricultural Experiment Station

In Account With

Farm and Miscellaneous Receipts.

Dr.

	Balance from Previous Year	Receipts for 1939	Total
State Department of Agriculture	.....	$ 26,350.00	$ 26,350.00
Bankhead-Jones Offset Funds	.....	55,417.86	55,417.86
Apple Research	.....	4,929.42	4,929.42
Special endowments, industrial fellowships and similar grants	$2,687.55	7,482.80	10,170.35
Sales	1,048.78	14,595.48	15,644.26
Total	$3,736.33	$108,775.56	$112,511.89

Cr.

Salaries	$ 48,137.99
Labor	26,005.47
Stationery and office supplies	298.82
Scientific supplies, consumable	284.12
Feeding stuffs	4,679.45
Fertilizers	1,517.87
Sundry supplies	8,101.05
Communication service	885.17
Travel expense	4,263.90
Transportation of things	173.85
Publications	306.15
Heat, light, water, power	763.32
Contingent expenses	266.85
Furniture, furnishings and fixtures	881.00
Library	30.50
Scientific equipment	421.89
Tools, machinery and appliances	4,457.01
Livestock	1,975.00
Buildings	1,070.76
Land	367.50
Unexpended balance	7,624.22
Total	$112,511.89